Warning

The SIL725 Safety Annunciator described herein operates on a logic voltage of 24VDC.

As standard +24VDC is used for the field contact supply voltage.

External power supplies using higher voltage AC/DC primary sources and optional high voltage field contact voltages may be present.

If this is the case please ensure the necessary precautions are taken.

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CONTENTS

1. Introduction 7

1.1 Installation 8

Unpacking 8
Basic principles of handling 8

Front View Examples 9

2. Functional Safety 10

2.1 IEC 61508 10
2.2 Second Tier Standards 10
2.3 Overview of the Safety System 10
2.4 Input Devices 12
2.5 Common Safety Relays 13
2.6 Use of LED's and Horns in Safety Functions 14
2.7 Safety Description 14
2.8 Limits of Application 15
2.9 Certification 15
2.10 CASS 15
2.11 Proof Testing 16
2.12 Checklist Safety Related System 17
2.13 Hardware Failure Rates 17

3. System Description & Features 18

3.1 General 18
3.2 Window Colours 19
3.3 Laser Printed Legends 19
3.4 Adding or Changing Film Legends 20
3.5 LED Illumination 20
3.6 Window Numbering System 21
3.7 Alarm Card Types 22
3.8 Pushbutton / Configuration Module 22
3.9 Fully Field Configurable 22
3.10 Integral Audible Alarm 23
3.11 Remote Pushbutton Inputs 24
3.12 Terminations 25
3.13 Failsafe Mode 25

4. Inputs 26

4.1 Optically Coupled Inputs 26
4.2 Standard Input Configuration 26
4.3 Typical Signal Supply Voltage 26
4.4 External Signal Supply Voltage 27
4.5 Input Time Delay – Option AD 27*
4.6 Input Wiring Segregation 27
4.7 No Master Module 27

5. Common Safety Relay Outputs 28

5.1 Horn Relay A - HNA 29
5.2 Horn Relay B - HNB (optional) 29
5.3 Group Relay A – GPA 29
5.4 Group Relay B – GPB (optional) 29
5.5 Common Safety Relay Function Codes 30
5.6 Low Voltage Lockout (LVL) Board 31

6. Technical Specifications 32
6.1 General 33
6.2 Fuse Details - SPD Module 33
6.3 Fuse Details - SIO Module 33
6.4 Suitable Power Supplies 34
6.6 SIL725 Safety Annunciators 35
6.7 SIL725 Safety Annunciators Fitted With Repeat Relays Per Channel 35

7. Mechanical Details 36
7.1 SIL725 Overall and Cut Out Dimensions 36
7.2 System Capacity 36
7.3 Panel Mounting Clamps 37

8. Alarm Sequences 38
8.1 Summary 38
8.2 Audible Alarm Grouping 38

9. Additional Features 39
9.1 Automatic Reset 39
9.2 Non-Latch Sequence (No Lock-In) 39
9.3 Reflash Feature 39
9.4 Ringback Sequence 39
9.5 Two Pushbutton Operation 39
9.6 First-Up Sequences 39

10. Sequence Configuration and Tables 41
10.1 ISA-Sequence M 41
10.2 ISA-Sequence A 42
10.3 ISA-A-4 Sequence 43
10.4 ISA-R Sequence - 44
10.5 ISA-F2M-1 Sequence 46
10.6 ISA-F3A Sequence - 48

11. Options 50
11.1 General 50
11.2 LED Assemblies 50
11.3 Tropicalisation 50
11.4 Individual Channel Repeat Relays (Option RLY) 50
*11.5 Customer Specified Response Time (Option CRT**) 51*
11.6 Customer Adjustable Response Time (Option AD) 51*
11.7 SPD Module (Supply-Pushbutton Module) 52
11.8 Logic Power Connections 52
11.9 Signal Supply Voltage Connections 52
11.10 Power & Remote P.B. Connections 53

12. Large Window Alarm Module Wiring 54
12.1 Standard Unit without Repeat Relay Facility 54
12.2 Optional Unit with Repeat Relay Facility 55

13. Medium Window Alarm Module Wiring 56
13.1 Standard Version without Repeat Relay Facility 56
13.2 Optional Version with Repeat Relay Facility 57
14.1 Standard Systems Using Externally Powered Inputs 59

17. System Configurations 64
17.1 Configuration Mode 64
17.2 Changing a Function Setting 65

17.3 Configuration Example 66
17.4 Checking Configuration Settings 66
17.5 Systems with Unarmed Ways 66
17.6 Points to Note when Configuring 66

18. Function No Key and Descriptions 67

19. Function Descriptions 69

20. Alarm Card Address Settings 74
21.1 Set Output Drive to Operate With LED's 74

21. Adjustable Response Times 79

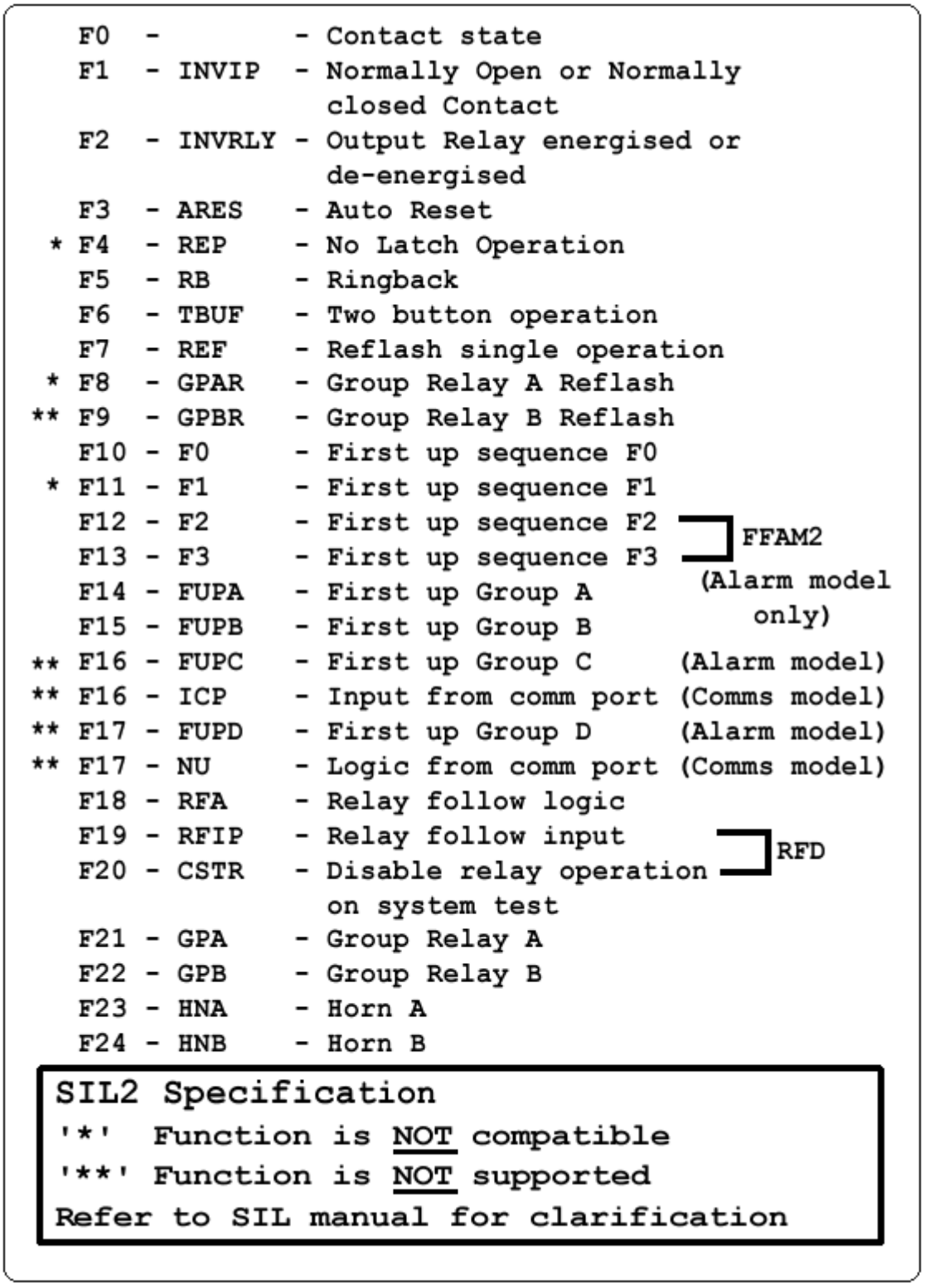
22. Safety Calculations 82
22.1 What is in this chapter 82
22.2 Modes of operation 82
22.3 Single channel 1oo1 83
22.4 Two channel, 1oo2 on the same input card 85
22.5 Two channel, 1oo2 on the different input cards 87
22.6 Calculation of Probabilty of Failure on Demand 89
22.7 Proof tests 89
22.8 Calculating PFD for each safety function 90

23. Commissioning 93

24. Maintenance 94
24.1 No Special Tools 94
24.2 Removing Filter Assemblies 94
24.3 Changing Film Legend 94
24.4 Changing LED Assemblies 94
24.5 Fuse Replacement 95

25. Spare Parts Description 96

26. Other RTK Products 97


F0 - - Contact state
F1 - INVIP - Normally Open or Normally closed Contact
F2 - INVRLY - Output Relay energised or de-energised
F3 - ARES - Auto Reset
* F4 - REP - No Latch Operation
F5 - RB - Ringback
F6 - TBUF - Two button operation
F7 - REF - Reflash single operation
* F8 - GPAR - Group Relay A Reflash
** F9 - GPBR - Group Relay B Reflash
F10 - F0 - First up sequence F0
* F11 - F1 - First up sequence F1
F12 - F2 - First up sequence F2
F13 - F3 - First up sequence F3
FFAM2
(Alarm model only)
F14 - FUPA - First up Group A
F15 - FUPB - First up Group B
** F16 - FUPC - First up Group C (Alarm model)
** F16 - ICP - Input from comm port (Comms model)
** F17 - FUPD - First up Group D (Alarm model)
** F17 - NU - Logic from comm port (Comms model)
F18 - RFA - Relay follow logic
F19 - RFIP - Relay follow input
F20 - CSTR - Disable relay operation on system test
RFD
F21 - GPA - Group Relay A
F22 - GPB - Group Relay B
F23 - HNA - Horn A
F24 - HNB - Horn B
SIL2 Specification
'*' Function is NOT compatible
'**' Function is NOT supported
Refer to SIL manual for clarification

.98

1. Introduction

The RTK SIL725 Safety Annunciator is designed and manufactured to provide a high level of availability for critical alarm applications and for use as a component part of a safety instrumented system. It is based on the well-proven P725 with the addition of enhanced circuitry for safety-critical applications. The SIL725 is third party certified by SIRA using the CASS Scheme, for use in safety functions up to a safety integrity level of SIL2.

WARNING
This Safety Related product should only be used in accordance with the limitations as detailed on the following pages.

Safety Integrity can only be maintained if the product is used within these limitations.

Only qualified personnel with appropriate knowledge of the IEC61508 standard should utilise this product as part of a safety instrumented system

The Annunciator is used to provide visual and audible warning that a process has gone beyond set limits or to provide status only indication. The safety relay outputs may be used to drive inputs of a safety control system for example, or may be used directly to initiate a safety function.

The Annunciator is manufactured from universal cells, each 60 x 60mm, which can be assembled in an array to provide the number of rows and columns required to suit individual panel designs.

Each cell within the Annunciator is able to contain either:- one large, or two medium alarm windows, which are illuminated by “fit and forget” LED Assemblies.

The assembled unit is fully field Configurable which allows the user to enable a number of pre-defined features to control the operation of the Annunciator with regards to alarm sequence, horn groups, common alarm groups etc

Selection of features is on a per channel basis with no special tools required. All configurations are carried out from the front of the unit using the integral pushbutton / configuration module, which allows changes to be easily made during commissioning or at a later date after the equipment has been installed.

Alarm cards are fully interchangeable within the Annunciator

Reliability of operation is increased over conventional Annunciators as each alarm card is fitted with its own application specific integrated circuit (ASIC), which is capable of complete system control. During initial power up one of the alarm cards will automatically act as a master controller with regards to flash rates etc and in the event that this card fails or is removed another card will automatically take over the role of master controller.

Each Annunciator can be supplied with a maximum of four integrally mounted safety relays which can be used to provide 2 x horn outputs and 2 x common alarm group outputs

Additional options exist for more complex requirements including signal duplicating relays and user selectable time delays per channel.

Accessibility for normal maintenance, LED changes, legend/filter changes and configuration is accomplished from the front of the panel without the use of special tools.

1.1 Installation

Unpacking

Once the item has been unpacked please visually examine the unit for any signs of transit damage before installing the unit into the control system. If any damage has occurred please report the damage to the freight forwarder and copy RTK. The alarm annunciator is supplied with panel mounting clamps locked in place, however please check all packages to ensure that no additional pieces are left in the box as any auxillary items like power supplies, horns, pushbuttons or spares kits will be packed separately.

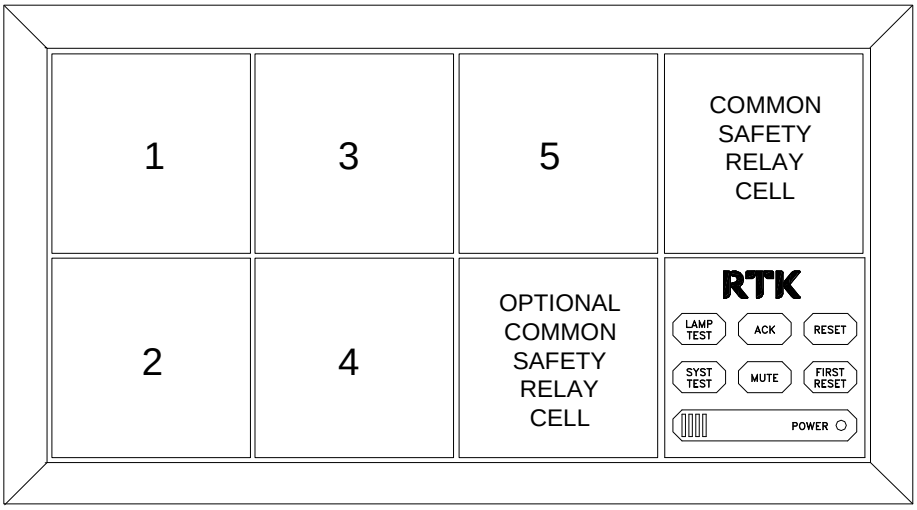
Please double check that all items listed on the packing list have been unpacked before disposing of any packing material.

Basic principles of handling

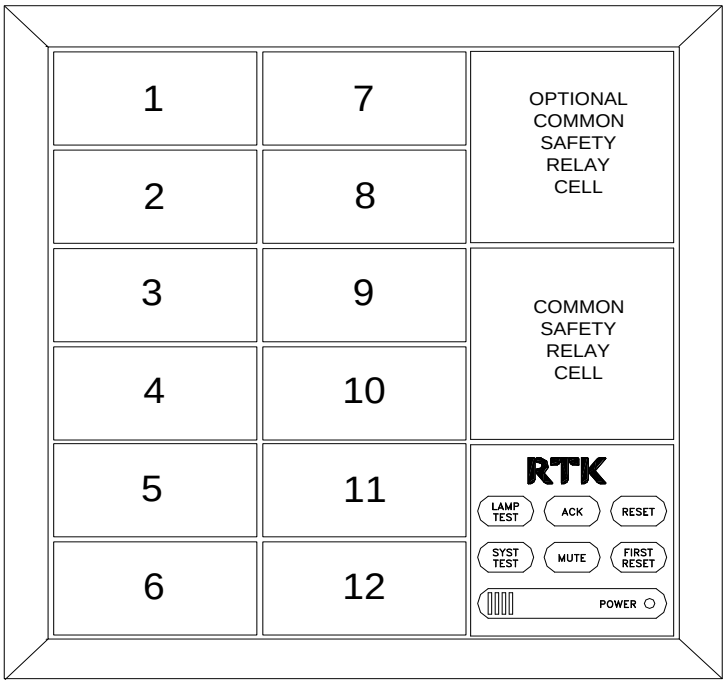
There are some basic principles that everyone should observe prior to carrying / lifting a large annunciator:

- Ensure that the object is light enough to lift, is stable and unlikely to shift or move.
- If the object is two heavy or awkward for one person to safely lift ask for help or use a handling aid.
- Make sure the route is clear of obstructions.
- Make sure there is somewhere to put the load down wherever it is to be moved to.
- Stand as close to the load as possible, and spread your feet to shoulder width.
- Bend your knees and try and keep the back's natural, upright posture.
- Grasp the load firmly as close to the body as you can.
- Use the legs to lift the load in a smooth motion as this offers more leverage reducing the strain on your back.
- Carry the load close to the body with the elbows tucked into the body.
- Avoid twisting the body as much as possible by turning your feet to position yourself with the load.

Front View Examples



Typical Large Window Version



Typical Medium Window Version

2. Functional Safety

2.1 IEC 61508

IEC 61508 Functional safety of electrical/electronic/programmable electronic safety-related systems, Parts 1-7, is the basic safety standard covering the management of functional safety, and the implementation and use of equipment in functional safety systems.

The standard uses a life-cycle approach that covers the whole life-cycle of the system from initial risk assessment through allocation of safety requirements, design and build, installation, commissioning and maintenance. The SIL725 complies with IEC 61508 as a component part of a safety system. It is the user's responsibility to ensure that the SIL725 is properly installed and used in accordance with IEC 61508 and with the limitations in this manual, and that all the relevant requirements of IEC 61508 are met for the complete safety system.

2.2 Second Tier Standards

There are a number of sector specific standards now published, known as second tier standards.

Two of these are relevant to the use of the SIL725:-

1. IEC61511 Safety Instrumented systems for the process sector, Parts 1-3

2. IEC61513 – Nuclear Power plants – Instrumentation and control important to safety – General requirements for systems

Being compliant to the generic IEC61508 standard will automatically mean that the SIL725 can be used as a component part of any system or process that needs to comply with these sector specific standards

2.3 Overview of the Safety System

The SIL725 accepts inputs from volt-free contacts, such as pressure or level switches, or contact outputs from trip amplifiers etc.

When an input is asserted, an alarm window is illuminated and a horn sounds to alert the operator. Relay contact outputs are also provided to pass the alarm signal onwards to other equipment.

These relay contacts are provided as group relays that may be associated with one or a number of inputs by configuring the SIL725.

(Each channel may optionally be fitted with a channel repeat relay. If fitted, channel repeat relays shall not be used in a safety function.)

When a new alarm occurs the alarm window flashes to show the sequence in which a number of near-simultaneous alarms occur, the first alarm to occur in a group flashes in a different manner to subsequent alarms in the group.

Alarms may be acknowledged by the operator, at which the windows stop flashing and illuminate steadily.

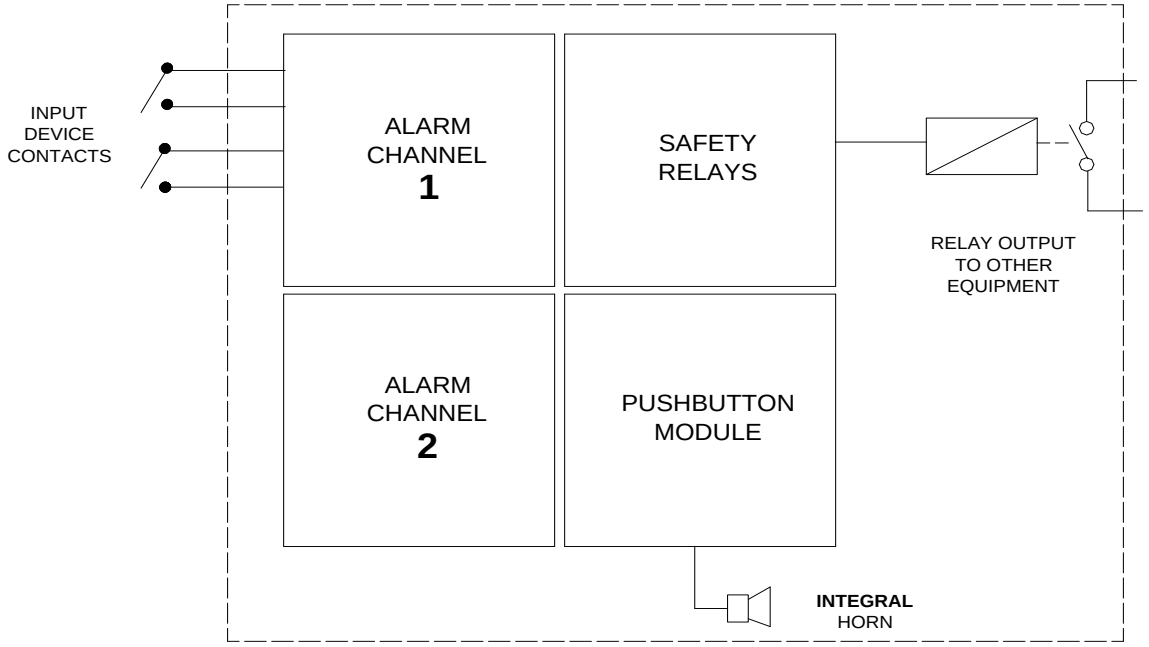
The exact manner in which the SIL725 reacts to a sequence of alarms depends on the sequence programmed – see Section 10.

The diagram is intended to illustrate the basic features of the SIL725 rather than to represent a particular implementation.

SIL725 systems are built using cells arranged in a matrix, and so may be one of a range of possible sizes and hence number of channels.

Configuration is performed using the pushbutton/configuration module which occupies the bottom right cell.

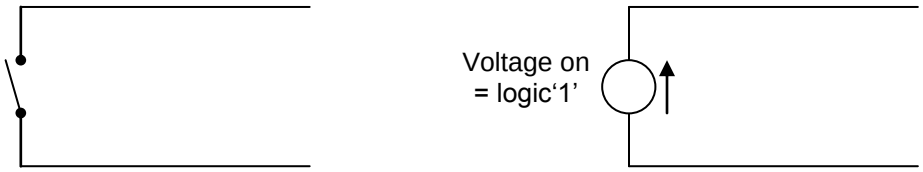
Configuration is enabled by prising the module away from the panel using a screwdriver to gain access to the configuration switch.



SCOPE OF SIL725 SHOWN INSIDE THE DASHED LINES

2.4 Input Devices

Standard P725 alarm annunciators are most often used with volt-free contact input devices, although voltage-sourcing inputs may also be used as long as the user strictly adheres to the maximum input voltage range.



Volt-free contact

Voltage-sourcing

Input devices for the SIL725 will be of these general types as shown, voltage-sourcing devices or volt-free contacts.

Input cards are configured to accept voltage-sourcing or volt-free inputs according to the rear-panel wiring terminals used.

Alarm input contacts must be normally closed. (Open to alarm)

When volt-free contacts are used, the safety system designer must consider the potential impact of line faults on each safety function.

Dual redundant input devices may be used on a single safety function to improve the safety reliability.

For resilience against line failures, voltage-sourcing inputs should be configured so that the absence of a voltage asserts the safety function.

Signal conditioning devices such as trip amplifiers and proximity detector amplifiers may also be used to drive the SIL725 inputs.

Any input channel may be used for a safety-related function.

Each alarm channel drives a dedicated alarm window.

Any channel, or combinations of channels, may be configured to drive one or more of the horn or group output relays.

The SIL725 itself meets SIL2 requirements with a single input channel, 1oo1. However, consideration of the safety integrity of the input devices and field wiring may require dual redundant inputs arranged in 1oo2 so that the safety function is demanded if either input is asserted.

2.5 Common Safety Relays

A maximum of 4 Common Safety Relays are available per SIL725 Annunciator

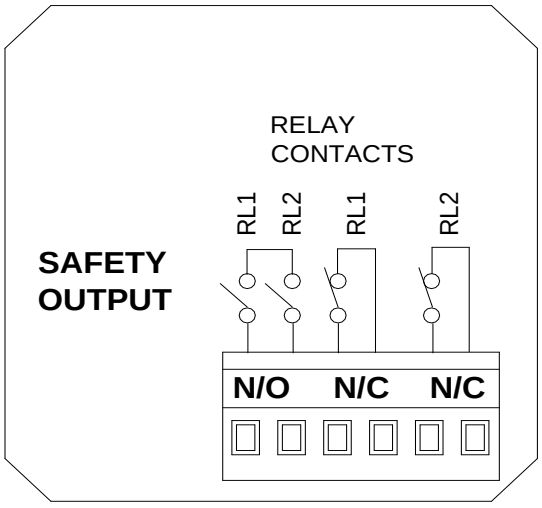
1. HNA = Horn Relay A
2. HNB = Horn Relay B
3. GPA = Group Relay A
4. GPB = Group Relay B

All of the safety relays are normally energised during normal conditions and will de-energise in the alarm state. The safe state of an output relay is when the relay is de-energised. Hence safety functions should always be designed so that the demand state is when the relay is de-energised.

Any channel can be configured to operate any of the common safety relays within the SIL725 as required. The output relays have normally open and normally closed contacts as typically shown for the HNA relay below.

Each relay card is equipped with two relays

1. Normally open contacts are internally wired in series as shown below.
2. Normally closed contacts are available individually as this allows the user to wire duplicate feeds for increased reliability



In the majority of applications the normally open contact will be used to open a circuit when the safety function is demanded. However, in some applications, a contact that closes when the safety function is demanded is required for example an external audible alarm.

SIL725 output relay cards provide two normally-closed contacts that operate together.

To meet SIL2 safety requirements, the two contacts must either be wired in parallel, or wired separately to the equipment being controlled, so that either contact closing will demand the safety function. Separate wiring provides some resilience to breaks in the wiring.

2.6 Use of LED's and Horns in Safety Functions

The LED's and the internal horn may be used in a safety function.

However, users should understand that the human operator responding to the LED's or horn is then an element in the safety function.

The reliability of human operators responding to safety alarms is questionable, especially if there is not much time for the operator to consider his actions before the process becomes dangerous.

Consequently, the use of human operators as a link in the safety function should be considered very carefully.

2.7 Safety Description

It is essential that the SIL725 is used correctly within a safety related system, hence the functional safety description is defined very clearly and this is included in the certificate.

The details are as follows:-

The SIL725 will provide an alarm system which, when used as specified, will provide functional safety as defined below.

a) The SIL725 may be used in low demand or high demand safety functions up to SIL2 in which the safe state and the demand state is with the output relays de-energised.

b) On alarm contact opening or loss of signal voltage on an input channel the related alarm window will be illuminated.

c) Alarm inputs shall be configured to assert on an open contact (contact input) or on a loss of input voltage (voltage input).

d) When an alarm input that is configured to drive horn relay Horn A is asserted, the integral horn shall sound until muted or acknowledged.

e) When an alarm input that is configured to drive an output relay (Horn A, Horn B, Group A or Group B) is asserted, the relay shall de-energise.

2.8 Limits of Application

The following limits of application must be observed.

a) The SIL725 is designed to have a 10 year lifetime. The certified failure rates are valid only for this lifetime.

b) A regular proof test of the complete system must be performed, see section 2.11

c) The SIL725 must be operated within the specified environmental and electrical limits

d) Alarm contacts must be normally closed, open to alarm.

e) Relays must be energised in normal use and de-energise on alarm

f) Loss of the power supply will prevent the internal horn sounding and the alarm windows illuminating. The failure rate of the power supply must be taken into account if the internal horn or an alarm window is used as part of a safety function.

g) Internal automatic diagnostic circuits monitor some important parts of the SIL725. The diagnostic must be set either to de-energise the safety relays or to activate an external alarm on detection of a fault. See separate section detailing the function of the Low Voltage Lockout Relay Card

h) Whenever a change is made to the configuration a complete functional test of the system must be carried out to ensure that all safety functions are operating correctly.

i) First-up sequence F1 (Configuration Setting F11) shall not be used.

j) All SIL725 Annunciators should be powered via a general purpose, single phase EMI filter. See chapter 6.5 For more details on the type of filter which should be used.

2.9 Certification

The SIL725 is certified by Sira Certification Services using the CASS methodology for use in safety functions up to safety integrity level SIL2.

The CASS methodology provides a framework for assessment and certification that is open, consistent, and traceable.

Traceable certification provides the end user with the assurance both that the product design complies with IEC 61508, and that the company has the necessary quality management systems to be able to manufacture the product in a repeatable and controlled manner

2.10 CASS

The Conformity Assessment of Safety-related Systems (CASS) methodology enables accredited third party certification bodies to offer consistent and transparent conformity assessment for safety related products and management systems that meet the requirements of IEC61508

2.11 Proof Testing

As specified in the limits of application the SIL725 should be subject to proof test during commissioning and then at regular intervals as necessary to achieve and maintain the required PFD (probability of failure on demand).

It is highly recommended that a proof test is performed at least every three years.

It is also recommended that a basic System Test is performed at every shift-change using the integral System Test facility especially if the internal horn or any alarm window is used as part of a safety function – see proof section of this manual

The proof test should normally include the following checks. Before making any checks ensure it is safe to do so within the plant as output relays may be connected to sections of the instrumentation and safety system.

a) Visual check of the product for any signs of misuse or environmental stress or damage that may cause the unit to operate outside specified limits

b) Ensure equipment is earthed correctly and all the customer connections are free from earth faults

c) Visually inspect all the wiring and connectors to ensure all wiring/connections are secure and correctly wired

d) Check the 24VDC supply voltage is stable and within specified limits

e) Press Lamp test and ensure all windows illuminate and the internal horn sounds

f) Press System Test to ensure all active windows flash and horn sounds in accordance with the programmed sequence, press ACK and RESET to return to normal

g) Repeat this test and ensure the two group relays and two horn relays are de-energised on test and return to normal after pressing ACK and RESET

h) Access the Pushbutton/Configuration module and enable the configuration feature. Check through the configuration details to ensure no un-authorised changes have been made and the configuration is correct (please refer to the section on configuration within the manual for details)

i) For each channel trigger an alarm by opening the alarm contact, this can be done by simulating an alarm or triggering the alarm sensor depending on the application. This should trigger the correct window, sound the integral horn (if configured) de-energise any configured horn relays and de-energise any configured group relays

j) When each channel is triggered ensure the window colour and film legend is correct

k) Check that the diagnostic relay contacts are open when the SIL725 is unpowered.

2.12 Checklist Safety Related System

Care must be taken to ensure the SIL725 is used correctly and in accordance with the certification, this simple checklist can help identify any points not considered

a) Have the Limits of Applications been adhered to

b) Have the environmental limits been considered and adhered to in all operating conditions

c) Have the electrical limits been considered and adhered to in all operating conditions

d) Has a full proof test been undertaken successfully as above at installation and regularly thereafter?

2.13 Hardware Failure Rates

Hardware failure rates and other information necessary for the use of the SIL725 are described later in this manual

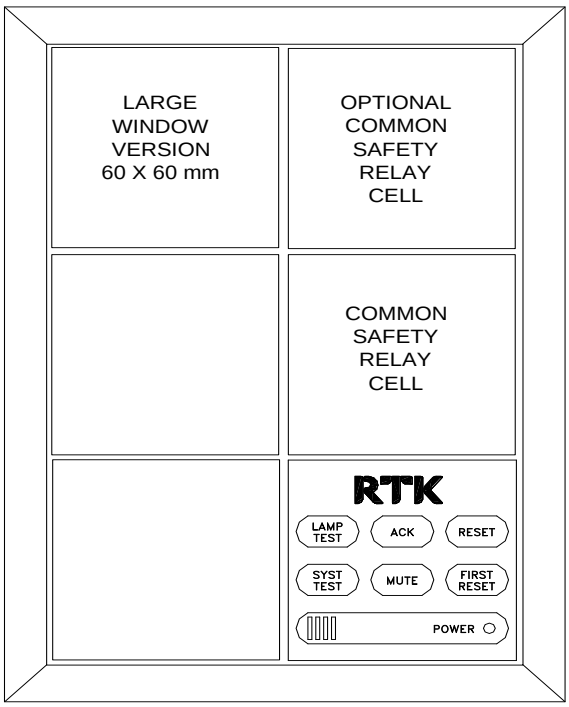
3. System Description & Features

3.1 General

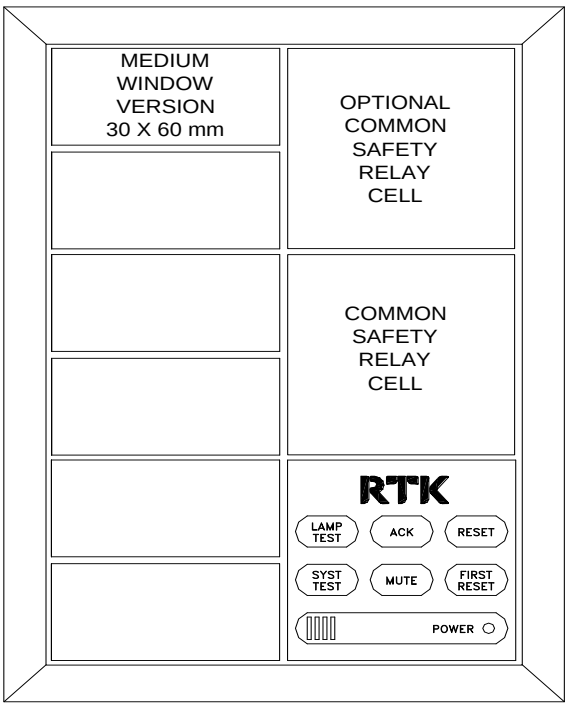
SIL725 Safety Annunciators are manufactured to meet individual customer's requirements using separate "cells" which can be assembled in configurations from 1 to 16 cells high and 1 to 16 cells wide as required.

The finished array is “picture framed” using standard lengths of aluminium extrusion. Individual alarm channels can be displayed in one of two sizes as typically shown below

Typical Large Window Version



Typical Medium Window Version



3.2 Window Colours

Coloured filters can be used to identify alarm importance or alarm type for example: Red filters can be used on Trip Alarms and Amber filters can be used for Pre-Trip conditions.

Each channel is equipped with its own removable bezel, which contains

1. A clear lens
2. White diffuser
3. Coloured filter
4. Laser printed film legend.

The following table details the associated part numbers for spare parts ordering purposes.

Part	***Medium Window***	***Large Window***
Bezel	ID-SLC-3WH-B	ID-SLC-3WG-B
Clear Lens	ID-SLC-3LH	ID-SLC-3LG
White Diffuser	ID-SLC-3PH-WH	ID-SLC- 3PG-WH
Clear filter (used with white windows)	ID-SLC-3PH-C	ID-SLC- 3PG-C
Red filter	ID-SLC-3PH-R	ID-SLC- 3PG-R
Amber filter	ID-SLC-3PH-A	ID-SLC- 3PG-A
Yellow filter	ID-SLC-3PH-Y	ID-SLC- 3PG-Y
Blue filter	ID-SLC-3PH-B	ID-SLC- 3PG-B
Green filter	ID-SLC-3PH-GD	ID-SLC- 3PG-GD

3.3 Laser Printed Legends

Laser printed film legends are easily generated, from within Microsoft Excel, in a font, style, size and language to suit individual applications.

A software template is available, free of charge from RTK, which allows the user to produce film legends locally using acetate film and a laser printer.

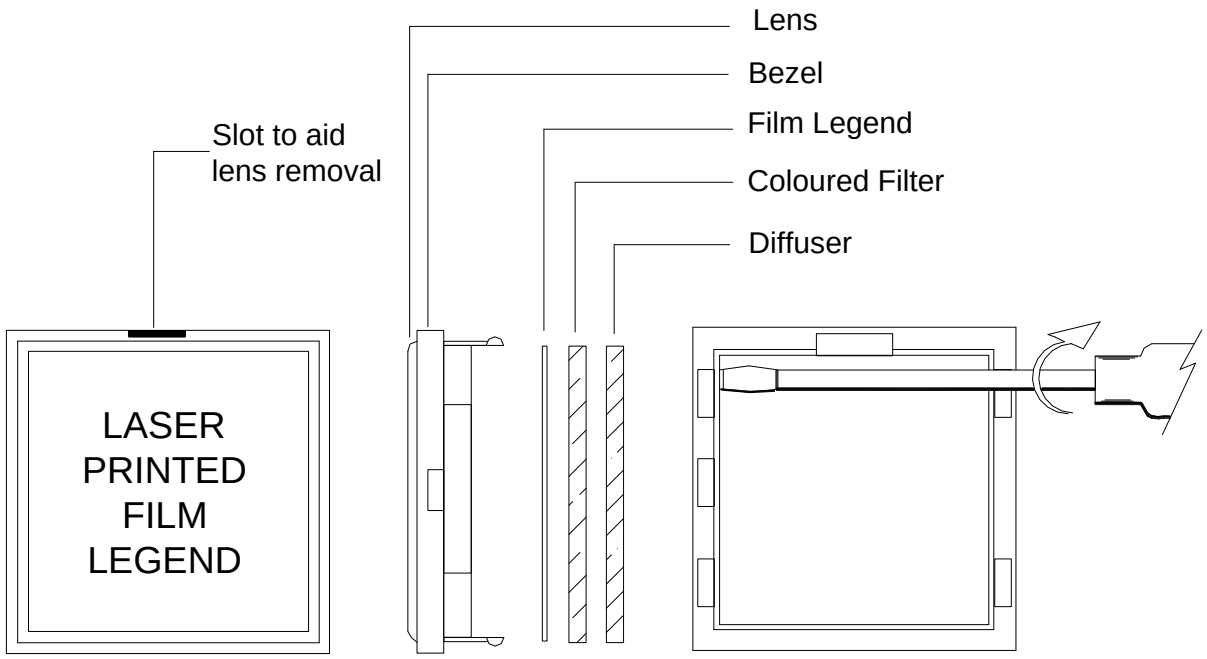
Completed film legends are located between the clear front lens of the removable window assembly and the associated coloured filter and diffuser.

3.4 Adding or Changing Film Legends

Each lens assembly has a small slot in the upper ridge of the surround bezel, which allows a flat blade terminal screwdriver to be used to gently lever the assembly forward.

Once the assembly has been removed the diffuser, coloured filter and film legend can be accessed using a flat blade screwdriver to gently lever the lens clear of the associated parts as indicated in the diagram below.

This MUST be levered on the side NOT the top or bottom



3.5 LED Illumination

All units are supplied with “fit and forget” LED assemblies. The colour of the LED can be changed to suit individual applications. The following colours are available.

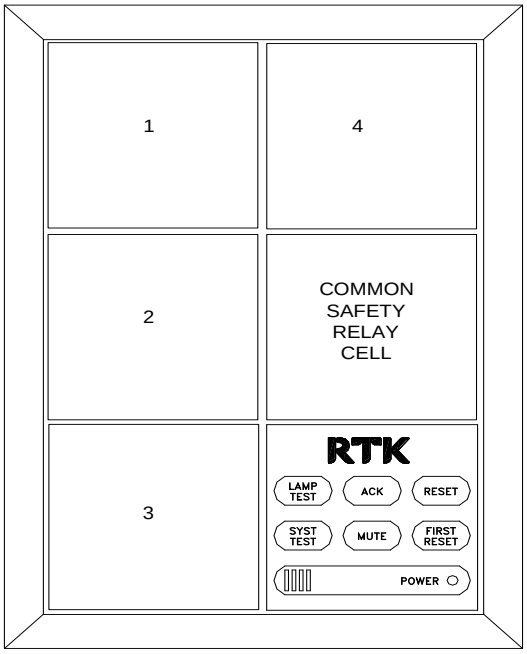
Part no. P725-LED-** ** = specify colour suffix using the table below

SUFFIX	COLOUR
RD	Red
YW	Yellow
AM	Amber
BL	Blue
GN	Green
WT	White

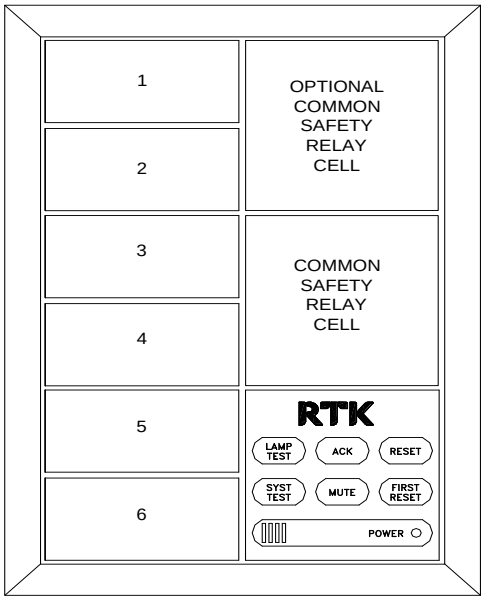
The LED assemblies plug into the associated lamp socket and can therefore be easily changed as required.

3.6 Window Numbering System

RTK have adopted the following window numbering system to aid with the location of the film legend and the associated alarm cards. This method is used to ensure that the legend matches the functions selected for the designated alarm.



TYPICAL LARGE WINDOW VERSION



TYPICAL MEDIUM WINDOW VERSION

3.7 Alarm Card Types

There are 4 basic types of dual channel alarm cards

PART NO	DESCRIPTION	USED ON
CB5674SIL1	2 Channel alarm card (Without repeat relays)	Large and medium window versions Locates in the upper slot of the associated cell
CB5674SIL2	2 Channel alarm card (With repeat relay facility)	Large and medium window versions Locates in the upper slot of the associated cell
CB5674SIL3	2 Channel alarm card (Without repeat relays)	Large and medium window versions Locates in the lower slot of the associated cell
CB5674SIL4	2 Channel alarm card (With repeat relay facility)	Large and medium window versions Locates in the lower slot of the associated cell

Card types are supplied suitable for operation from a signal supply voltages of 24VDC.

Alarm cards are plugged into the rear of the annunciator and once inserted automatically connect to a pre-tested passive display motherboard.

3.8 Pushbutton / Configuration Module

The SPD pushbutton/configuration module is located in the bottom right hand corner of the annunciator when viewed from the front.

It has a power-on LED, integral audible and six tactile pushbuttons to cover all of the possible sequence combinations.

The six pushbutton functions are:- Lamp Test, System Test, Mute, Acknowledge, Reset and First Reset

3.9 Fully Field Configurable

In addition to controlling the alarm sequence the pushbutton module is also used as a configuration tool to configure the required features on the annunciator.

To access the Configuration functions the pushbutton fascia must be hinged down to reveal a configuration switch (labelled CONF) located on the inner face of the assembly.

Once the unit is in the CONF mode the user is able to enable or disable a range of pre-defined features and options.

The dual function pushbutton assembly allows the user to enable any of the embedded features on a per channel basis without having to remove power from the annunciator, remove light-boxes, back-planes or alarm cards.

All configured information is stored in EEPROM, with minimum 20-year retention, giving repeatability and reliability without the need for battery backup.

Note:- Alarm sequences will operate in accordance with any of the standard sequences defined in the ISA publication "Alarm Sequences and Specifications S18.2 - 1979 (R1985)"

3.10 Integral Audible Alarm

Each annunciator is equipped with an internal 3.5kHz 95dB(A) audible located behind the integral pushbutton module.

The audible is supplied with an adjustable volume control using a single turn potentiometer.

The potentiometer can be accessed by hinging down the integral pushbutton module using a small flat blade screwdriver in the slot of the surround bezel.

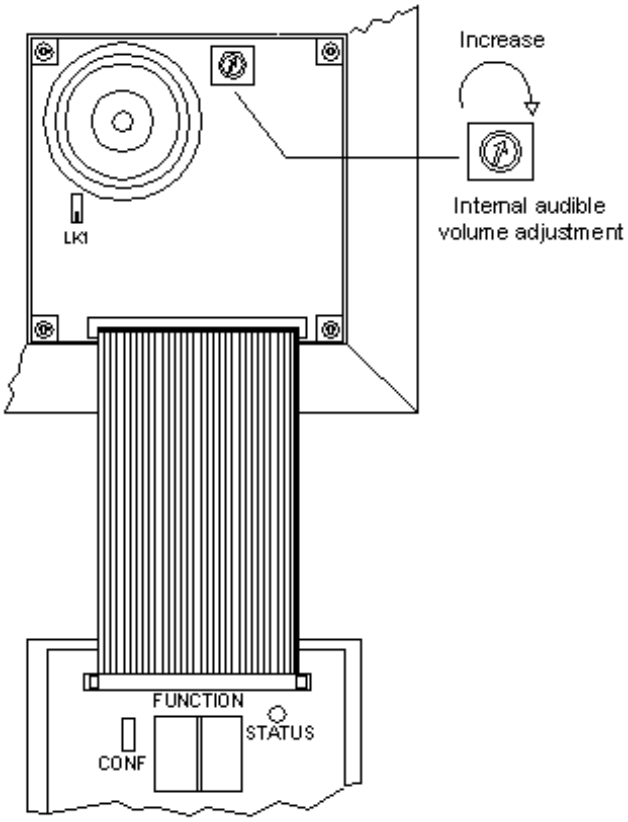
The potentiometer is located in the top right hand corner of the cell as shown below.

On systems with channels configured to activate either the HNA or optional HNB audible relays it is important to note that the internal audible will only operate on channels configured to operate the HNA relay (see Function F23).

A Jumper link LK1 is provided to enable/disable the horn during Lamp Test. The default position will enable the horn during Lamp Test.

LK1 is located to the lower left side of the horn.

Integral Horn Volume Adjustment Location



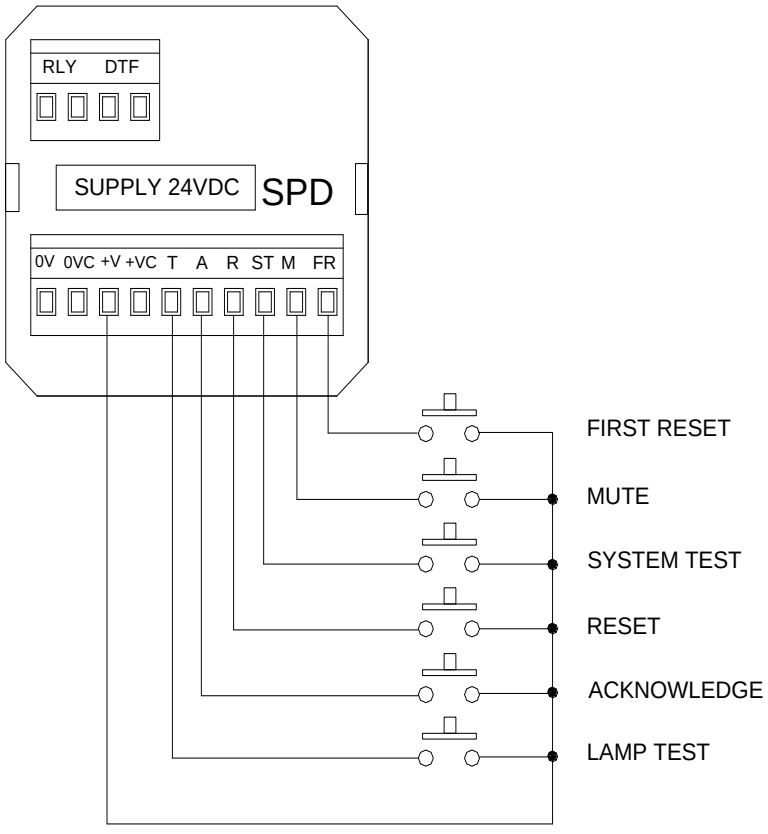
3.11 Remote Pushbutton Inputs

Remote pushbuttons can be connected to the SIL725 SPD module in addition to the integral pushbuttons or to allow multiple annunciators to share common pushbuttons for example a common mute pushbutton mounted in the operator desk console.

The pushbuttons should be of the normally open, momentary type and it is recommended that if long cable runs are required through electrically noisy environments a screened cable is used with the screen connected to a suitable instrument earth at one end only.

Please note:-
When the annunciator is in the configuration mode with the CONF switch in the ON position all integral or remote pushbutton inputs are disabled until the unit has been returned to its normal operating state.

Remote Pushbutton Wiring



Please note:-
The common return for the remote pushbutton inputs is always +V (+24VDC).

3.12 Terminations

All active cells within the annunciator are provided with quick disconnect (2) part pluggable, rising clamp, terminals capable of accepting up to 2.5mm² cable.

In the unlikely event that a card fails the associated field wiring can remain connected and the terminal temporary unplugged to allow removal and replacement of the associated card.

3.13 Failsafe Mode

All relays are configured in their default setting as energised. (fail safe)

The relays will de-energise on trip or in the case of a power failure.

4. Inputs

4.1 Optically Coupled Inputs

All alarm inputs are provided with optical couplers and a transient filter is built into the input circuitry so that low voltage interference will be ignored.

4.2 Standard Input Configuration

The annunciator can be set to operate from volt free signal contacts that are either normally open or normally closed.

However in safety related applications it is mandatory to use N/C contacts (fail safe)

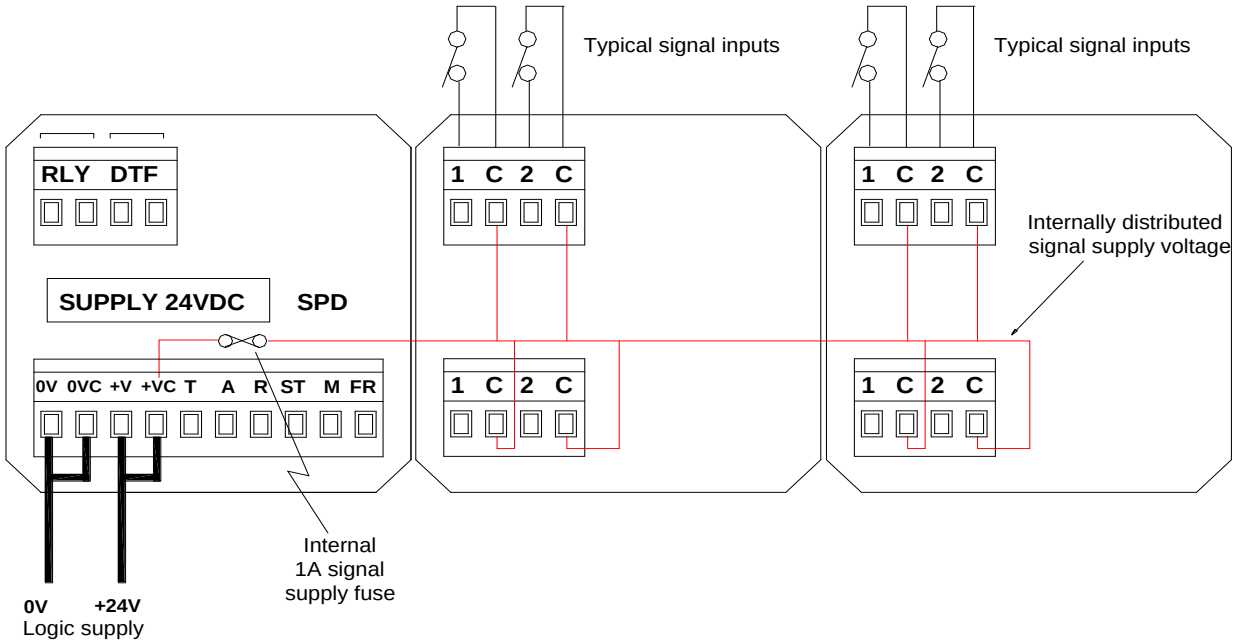
Setting function F1 to the “ON” state conditions the input to accept a normally closed contact.

Please Note: When AD* option is requested (see section 4.5 - Input Time delay - Option AD*). The alarm input should be set to normally closed using the switch SW2 located on each dual channel alarm card. Function F1 in the configuration menu should be off.

4.3 Typical Signal Supply Voltage

On standard units an internally fused 24vdc signal supply (+VC), derived from the 24VDC logic supply (+V), is distributed to all of the common terminals marked “C” which are located to the right of each signal input terminal as typically shown below.

Typical Signal Supply Voltage Distribution



4.4 External Signal Supply Voltage

Annunciators can be supplied suitable for connection to direct powered inputs as an option with the signal supply voltage being supplied from outside the annunciator by others. In this application the logic supply (0V and +V) and signal supply (0VC and +VC) inputs located on the SPD module are independently wired and fully isolated from each other.

OPTION CODE	VOLTAGE
Standard	24V AC/DC
FC048	48V AC/DC
FC125	125V AC/DC

4.5 Input Time Delay – Option AD*

As an option each channel can be provided with a potentiometer, which allows the user to select a time delay to prevent the alarm from occurring unless it has been present for a pre-defined period.

Three separate time ranges are available; please note the required option must be specified at time of order for the additional components to be added to the alarm card

1. Option AD1 = Adjustable Delay Range 5 – 50 ms
2. Option AD2 = Adjustable Delay Range 20ms - 2 seconds
3. Option AD3 = Adjustable Delay Range 5ms – 5 seconds

The AD* option allows the user to have a fast return to normal mode.

This means the user can have a delay on the input when the process is going from normal to active state, but when the process returns to normal there is no delay. The feature is activated using switch SW2/DM on the alarm card.

4.6 Input Wiring Segregation

Field contacts are often great distances from the annunciator it is therefore advisable to run the contact cables separately from circuits carrying heavy currents and/or high voltages to minimise the effects of induced voltages.

4.7 No Master Module

Each dual channel alarm card is equipped with a dedicated application specific integrated circuit (ASIC).

System control is automatically allocated to one of the alarm cards during power on and if this card is removed, damaged or fails (apart from catastrophic failure), another card will automatically take over the common control functions.

This method of operation eliminates the need for a traditional style common services/control module and removes common failure points thus increasing reliability.

5. Common Safety Relay Outputs

On SIL725 Alarm Annunciators a maximum of (4) Common Safety Relays can be used to provide the following functions:-

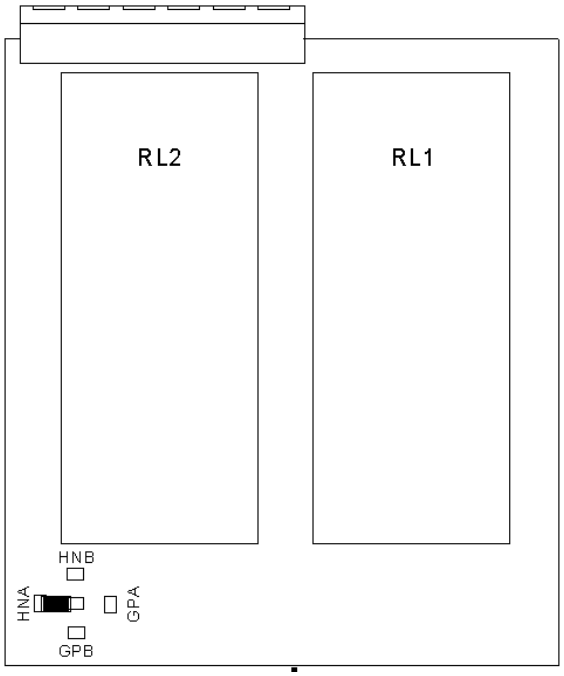
1. HNA = Horn Relay A
2. GPA = Group Relay A
3. HNB = Horn Relay B
4. GPB = Group Relay B

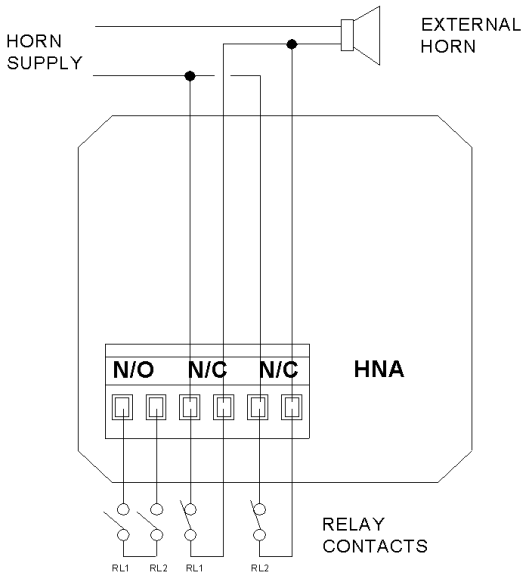
Dedicated cells are required within the Annunciator to house the associated relay cards

1. 1 x cell is required for the HNA Safety Relay Card (Fitted as standard)
2. 1 x cell is required for the GPA Safety Relay Card (Fitted as standard)
3. 1 x cell is required for the HNB Safety Relay Card (Optional)
4. 1 x cell is required for the GPB Safety Relay Card (Optional)

Although relay cards look identical each function requires a dedicated card with redundant relays and the specific function is determined by a single zero ohm link:-

Safety Relay board with HNA Function





Rear view of typical SIL Safety Relay Cell

5.1 Horn Relay A - HNA

Each channel can be set to operate the HNA horn relay as required.

When an alarm occurs the horn relay will change state and remain in the alarm condition until the MUTE or ACK pushbutton has been pressed.

Please note:- Channels set to operate the HNA horn relay will also operate the integral audible alarm.

5.2 Horn Relay B - HNB (optional)

Each channel can be set to operate the HNB horn relay as required.

When an alarm occurs the relay will change state and remain in the alarm condition until the MUTE or ACK pushbutton has been pressed.

Please note:- Channels set to operate the HNB horn relay will not operate the integral audible alarm.

5.3 Group Relay A – GPA

Each channel can be set to operate the GPA relay as required.

When an alarm occurs the relay will change state and remain in the alarm condition until all alarms in the group have returned to normal and the logic has been reset.

5.4 Group Relay B – GPB (optional)

Each channel can be set to operate the GPB relay as required.

When an alarm occurs the relay will change state and remain in the alarm condition until all alarms in the group have returned to normal and the logic has been reset.

5.5 Common Safety Relay Function Codes

FEATURE DESCRIPTION	FUNCTION	SETTING
HNA horn relay enable	F23	ON
HNB horn relay enable	F24	ON
GPA group relay enable	F21	ON
GPB group relay enable	F22	ON

Please note:-

HNA and GPA safety relays require 2 x dedicated cells within the annunciator; This is normally provided in the cells above the pushbutton module.

If additional safety relays are required for horn relay HNB and / or group relay GPB 2 x additional dedicated cells would be provided within the annunciator for this purpose.

The “optional” HNB and GPB Safety Relays must be specified at time of order.

5.6 Low Voltage Lockout (LVL) Board

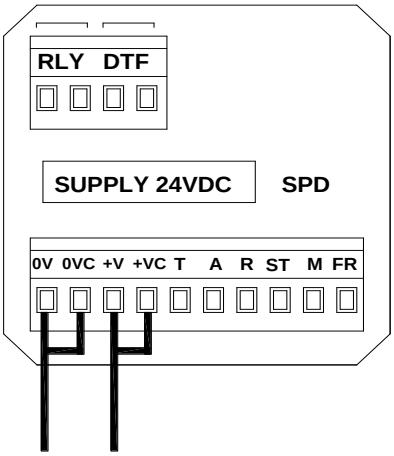
In SIL725 Alarm Annunciators additional self diagnostic functionality is added via a Low Voltage Lockout Board Part No. CB8306SIL

This board is located in the upper slot of the SPD Cell and is designed to monitor

- The logic supply of each alarm card
- The 1st-Up control line
- When the unit is in the configuration mode

The Low Voltage Lockout Boards relay will trip if any of the following conditions apply:-

1. If the logic voltage is detected as being low (card fault)
2. If the 1st-Up control line has been detected as being held low
3. If the annunciator is in the configuration mode



PLEASE NOTE:-

1. The Diagnostic relay operation is linked to the Safety Relays (GPA, GPB, HNA, HNB). i.e. If the diagnostic relay is de-energised it will cause the Safety relays to de-energise. However if a safety relay is de-energised it will not cause a diagnostic de- energise.
2. If the safety relays are required to work independently, a link should be placed across the DTF terminals. In these situations a different method for monitoring the diagnostic relay contact must be used. The diagnostic relay contact is open when the then relay is de-energised.
3. When the Annunciator is powered on the diagnostic relay will take approx 5 seconds to energise. If the DTF link is NOT made, the safety relays will remain un-energised and the audible will sound during this period.
4. If DTF is not made the Audible may sound for a short time when Alarm cards are being swapped.

6. Technical Specifications

The certified equipment shall be installed in accordance with the environmental specification stated by the manufacturer and any of the manufacturer's maximum ratings for the certified equipment shall not be exceeded.

FEATURES	**DETAILS**			
Input type	Each channel can be set to operate from either a normally open or normally closed contact as required			
Standard version Signal voltage	24VAC/DC	9V to 33V		
Contact resistance	Normally Closed 20k Ohm maximum series resistance			
	Normally Open 50k Ohm minimum parallel resistance			
Contact current	Typically 3mA			
Response time	Typically 35ms (alternatives available on request)			
First up	5ms Discrimination			
Input protection	Reverse polarity of the input supply Application of a 1000V megger tester between input and earth			
Input Delay	Options exist for fixed or adjustable input time delays. Adjustable delays AD1= user selectable from 5 to 50ms AD2 = user selectable from 20ms to 2 seconds AD3 = user selectable from 5ms to 5 seconds			
Internal audible	3.5 kHz @ 95db(A) At 1 Metre distance complete with volume adjustment (Functions as a slave of the HNA circuit)			
Common relays	Contacts rated 2.0A @ 24VDC Inductive Load, 4A @ 24VDC Resistive Load 0.3A @ 110VDC Inductive Load, 1A @ 110VDC Resistive Load 4.0A @ 240VAC			
Individual channel Repeat relay option	Each alarm can be supplied with an individual repeat relay with a changeover contact rated 2A@24VDC, 0.4A @120VAC resistive, 0.5A @ 125VDC resistive. Maximum voltage 220VDC (250VAC).			
Window sizes (H x W)	Medium 30 x 60 mm OR Large 60 x 60 mm			
Window colours	Red, Amber, Yellow, Green, White, or Blue			
Illumination	"fit & forget" LED assembly			
	Medium windows use dual LED arrays Large windows use quad LED arrays			
Alarm legends	Laser printed film legends plus software template if required			
EMC compliance	IMMUNITY TO BS EN61000-6-2:2005 EMISSIONS TO BS EN61000-6-4:2001			
LVD compliance	BS EN61010 1:1993			
Operating temp.	-20^{o}C to +60^{o}C	Storage Temp.	-20^{o}C to +80^{o}C	
Humidity	0 to 95% RH Non Condensing			
Protection	Front of panel	IP41	Rear of panel	IP20
Optional covers or wall mounting enclosures	IP54 to IP67 on request			
Terminals	Rising clamp type terminals. Maximum cable size 2.5mm^2			
Weight	Approx. 0.3kg per module			

6.1 General

Supply voltage:- 24VDC (21 to 28VDC)
Quiescent supply current 18mA per channel @ 24VDC

ALARM STATE CURRENT PER CHANNEL	FIT AND FORGET L.E.D. VERSION		
Window size	Medium window		Large window
Standard systems	40mA		80mA
Systems with repeat relays	50mA		90mA
Pushbutton Module	100mA		100mA

6.2 Fuse Details - SPD Module

FUSE	FUNCTION	RATING	TYPE	PURPOSE
F1	Logic supply	10A/T	20 x 5 mm	Protects the logic supply within the alarm annunciator
F2	Signal supply	1A/F	Surface mount	Protects the signal supply voltage feed to the common “C” terminals

6.3 Fuse Details - SIO Module

FUSE	FUNCTION	RATING	TYPE	PURPOSE
F1	Logic supply	5A/T	20 x 5 mm	Protects additional 24VDC supply feed when current required exceeds one SPD module
F2	Signal supply	1A/F	Surface mount	Protects the signal supply voltage feed to the common “C” terminals

6.4 Suitable Power Supplies

A suitable power supply would have over volts protection with safety shut-off Limited to 31 volts, or switch over to second power unit.

Note: IEC-61010 compliance requires the annunciator external power supply to be compliant to EN61010 or EN60950.

6.5 General Purpose EMI Filter

Unit should be fitted with a General Purpose, single phase, EMI filter with attenuation high performance. The filter should be suitable for the intended environment whilst meeting the following requirements.

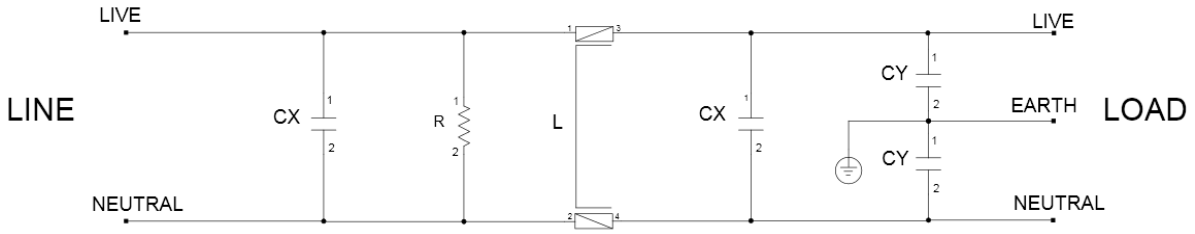
Technical Specifications

Maximum Continuous Operating voltage:	250VAC, 50/60Hz
Operating Frequency:	DC - 400Hz
Current Rating	Current rating should be suitable for the size of annunciator. Up to a maximum of 10A
Temperature Range (operation and Storage)	-25˚C to +85˚C (25/85/21)

The filter used should conform to the following Harmonised standards.

- EN133200
- UL1283

General Purpose EMI Filter Typical Electrical Schematic



A suitable filter can be supplied on request.

6.6 SIL725 Safety Annunciators

The table below indicates the maximum numbers of alarm channels that can be connected to a standard power supply from the RTK range of products. Each PSU provides a 24VDC output for use as the logic voltage to the annunciator.

PSU RATING	LED VERSION	
@ 24VDC	WINDOW TYPE	
CURRENT (A)	MEDIUM	LARGE
1.1	20	11
1.8	34	19
2.5	49	27
4.5	89	49
6.5	128	64

6.7 SIL725 Safety Annunciators Fitted With Repeat Relays Per Channel

PSU RATING	LED VERSION	
@ 24VDC	WINDOW TYPE	
CURRENT (A)	MEDIUM	LARGE
1.1	17	10
1.8	29	17
2.5	40	24
4.5	74	44
6.5	108	64

Larger PSU or multiple PSU can be used if required

7. Mechanical Details

7.1 SIL725 Overall and Cut Out Dimensions

CABINET DIMENSIONS IN MM						
HIGH				WIDE		
Cells	Overall	Cut-Out		Cells	Overall	Cut-Out
1	84	74		1	84	74
2	144	134		2	144	134
3	204	194		3	204	194
4	264	254		4	264	254
5	324	314		5	324	314
6	384	374		6	384	374
7	444	434	X	7	444	434
8	504	494		8	504	494
9	564	554		9	564	554
10	624	614		10	624	614
11	684	674		11	684	674
12	744	734		12	744	734
13	804	794		13	804	794
14	864	854		14	864	854
15	924	914		15	924	914
16	984	974		16	984	974

Please note:- The cut out tolerance should be with ±2mm. Annunciator depth is 145mm

Caution

The above table indicates the dimensions based on the number of cells high x cells wide this should not be confused with the number of alarm windows high and wide which can vary depending on required window size.

- When using Large Windows 60mm W x 60mm H there is 1 alarm per cell
- When using Medium Windows 60mm W x 30mm H there would be 2 alarms per cell

7.2 System Capacity

The maximum number of alarms available within a single annunciator is dependent on the maximum number of cards the system can address.

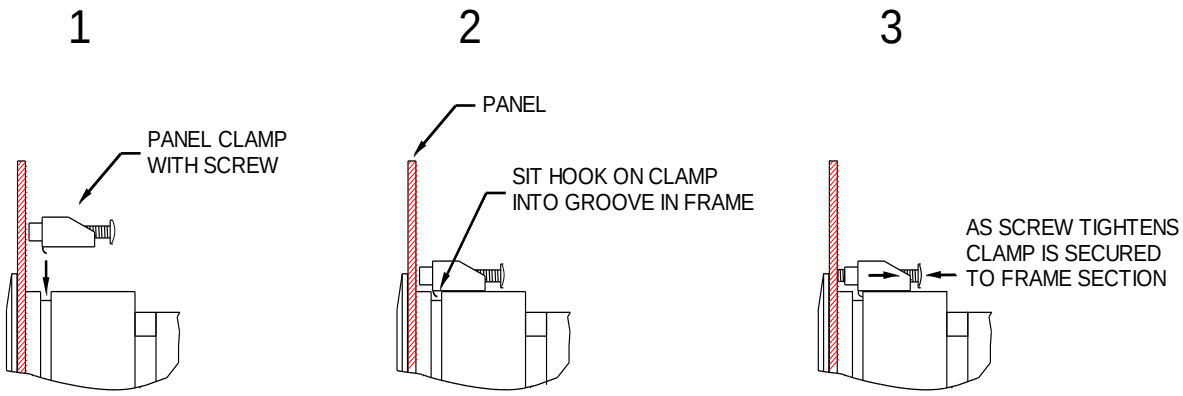
This is fixed at 128 two channel cards, making the maximum system 128 channels as each channel requires two independent inputs.

7.3 Panel Mounting Clamps

The annunciator is shipped with the panel mounting clamps fitted to the sides of the unit these must be removed to allow the unit to be placed in the panel cut out and secured from behind.

Once the unit has been placed in the panel cut out the panel clamps and screws are used to secure the unit as shown below. Maximum panel thickness 5mm

Securing the Annunciator into the panel



8. Alarm Sequences

8.1 Summary

Each channel within the annunciator can be set to operate in a pre-defined manner in accordance with internationally recognised standards ISA-S18.1 1979 (R2004) alarm sequences. Typically when an alarm occurs the associated window will flash and the operator uses specific pushbuttons to control the audible alarm and associated lamps or LED's:-

Lamp Test is used to test the LED's windows by illuminating them in a steady on state for as long as the pushbutton is pressed**.** The internal horn will also sound during this test

System Test is used to simulate a full functional test therefore all windows and horn circuits will operate in accordance with the selected sequence and additional pushbuttons will need to be pressed to step through the sequence and return the unit to its normal state.

Mute is used to silence the audible but allow the associated alarm window to continue to operate as per the selected sequence.

Acknowledge will silence the audible alarm and change the state of the associated window in accordance with the selected sequence.

Reset will return the alarm to the normal off state only if the unit has been acknowledged and the associated alarm contact has returned to its normal non-alarm state.

First Reset is used after acknowledge to reset the flash sequence on the first alarm to occur within a defined group of alarms. Once first reset has been pressed the next alarm to occur within the group will flash at the first-up alarm rate.

8.2 Audible Alarm Grouping

Each channel within the annunciator can be set to operate the audible alarm relays as follows:-

1. HNA horn relay
2. HNB horn relay (optionally fitted)
3. HNA & HNB horn relays
4. Neither of the horn relays (Typically status only alarms)

Please note channels, which are set to operate the HNA horn relay, will automatically operate the internal horn.

9. Additional Features

9.1 Automatic Reset

Once an alarm has been acknowledged and its input has returned to its normal state the alarm can be set to automatically reset without the operator having to press the reset pushbutton.

9.2 Non-Latch Sequence (No Lock-In)

Not recommended for SIL Safety Annunciators.

9.3 Reflash Feature

Not a compatible feature on the SIL725 annunciators

9.4 Ringback Sequence

Ringback sequence is used to visually inform the operator that an alarm condition has cleared and the channel can be reset to its normal off state. When a contact returns to normal the associated window will flash at approx ½ the speed of a normal alarm. This identifies the specific alarm and allows the operator to reset as soon as the process has returned to normal. Please note ringback cannot function if a channel is set to auto- reset or non lock- in.

9.5 Two Pushbutton Operation

In certain circumstances using remote pushbuttons, it may be desirable to use only two pushbuttons: reset and lamp test. The reset pushbutton is used to acknowledge an alarm if the contacts are in the alarm condition and to reset it if the contacts are clear.

9.6 First-Up Sequences

When monitoring devices with interlinked functions such as a turbine or compressor it is often important to know the specific alarm that occurred first, as it will invariably result in cascade of secondary alarms.

This allows the operator to focus on the root cause of failure and therefore limits the downtime and associated costs.

This is achieved by having the first-up alarm flashing in a different manner compared to the subsequent alarms.

IMPORTANT NOTE:

SIL725 Annunciators use 2 x Alarm channels for every customer input with the left hand section of each window being driven by one alarm card and the right hand section being driven by a separate alarm card.

When using First-Up sequences the quickest channel in the pair to respond will indicate First-Up and the 2nd channel will indicate as though it's a subsequent alarm.

This is normal as only one channel within the Annunciator can be considered as a First-Up master and all consequential alarms will flash at a different alarm rate.

Three different first-up sequences are available F0, F2 and F3 as detailed below and in the following sequence tables.

F0 The standard mode adopted by RTK Instruments, which indicates the first-up alarm by flashing at twice the rate of subsequent alarms.

F1 In sequence F1 subsequent alarms appear acknowledged and there is no audible indication This sequence is not a compatible feature as it does not comply with our Safety Requirements Specification.

F2 In this mode all subsequent alarms do not flash, they will however operate the audible device. The acknowledge pushbutton will reset the first-up indication.

F3 In this mode initial alarms appear with an intermittent flash rate and subsequent alarms flash at a steady rate. On acknowledge subsequent alarms revert to the steady on state and only the first alarm continues to flash at a slower rate.

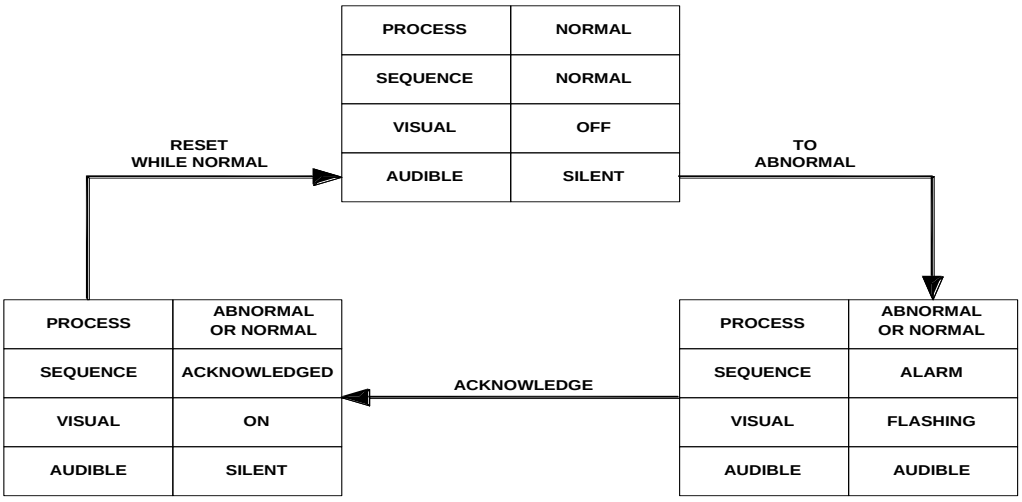
Please note auto reset and non lock-in functions are not recommended when using first up sequences as the true sequence of events cannot be guaranteed.

10. Sequence Configuration and Tables

Each pair of alarm channels can be configured to suit the operating sequence required, as listed in the ISA publication "Annunciator sequences and specifications" S18.1 1979.(R2004). Systems can be configured with different features on each individual channel and there is no need to switch the power off when making these changes. Different operating modes can be selected using the integral Pushbutton/Configuration module as described later in this manual. The following tables show the most commonly used examples.

10.1 **ISA-Sequence M** - Manual Reset

SEQUENCE DIAGRAM



SEQUENCE ISA M
(MANUAL RESET)

SEQUENCE TABLE

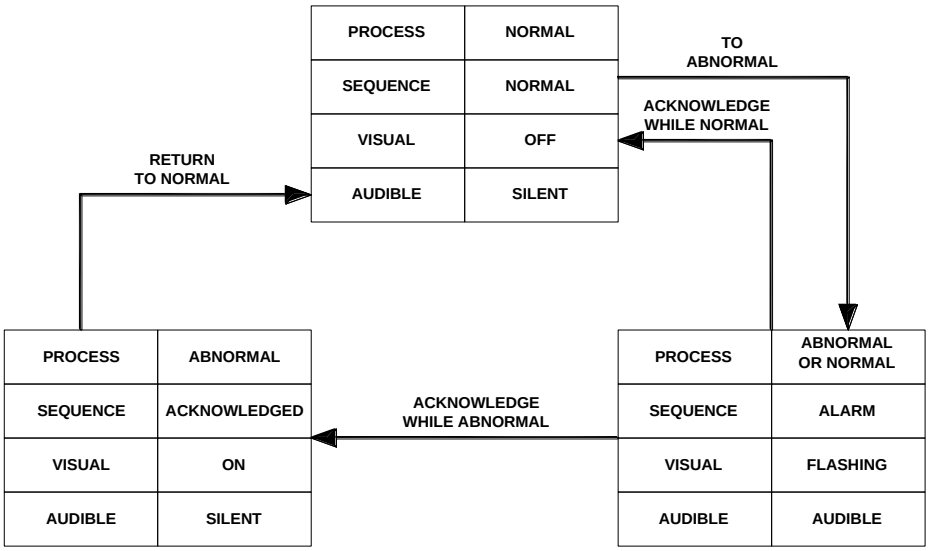
LINE	PROCESS CONDITION	PUSHBUTTON OPERATION	SEQUENCE STATE	VISUAL DISPLAY	ALARM AUDIBLE DEVICE	REMARKS
1	NORMAL		NORMAL	OFF	SILENT	
2	ABNORMAL		ALARM	FLASHING	AUDIBLE	LOCK-IN
3	ABNORMAL OR NORMAL	ACKNOWLEDGE	ACKNOWLEDGED	ON	SILENT	MANUAL RESET REQUIRED
4A	ABNORMAL	RESET	TO LINE 3			
4B	NORMAL	RESET	NORMAL	OFF	SILENT	MANUAL RESET

SEQUENCE FEATURES

1. ACKNOWLEDGE, RESET AND TEST PUSHBUTTONS
2. ALARM AUDIBLE DEVICE
3. LOCK-IN OF MOMENTARY ALARMS UNTIL ACKNOWLEDGED
4. THE AUDIBLE DEVICE IS SILENCED AND FLASHING STOPS WHEN ACKNOWLEDGED
5. MANUAL RESET OF ACKNOWLEDGED ALARM INDICATIONS AFTER PROCESS CONDITIONS RETURN TO NORMAL
6. OPERATION TEST

10.2 **ISA-Sequence A** - Automatic Reset

SEQUENCE DIAGRAM



SEQUENCE ISA A
(LOCK IN)

SEQUENCE TABLE

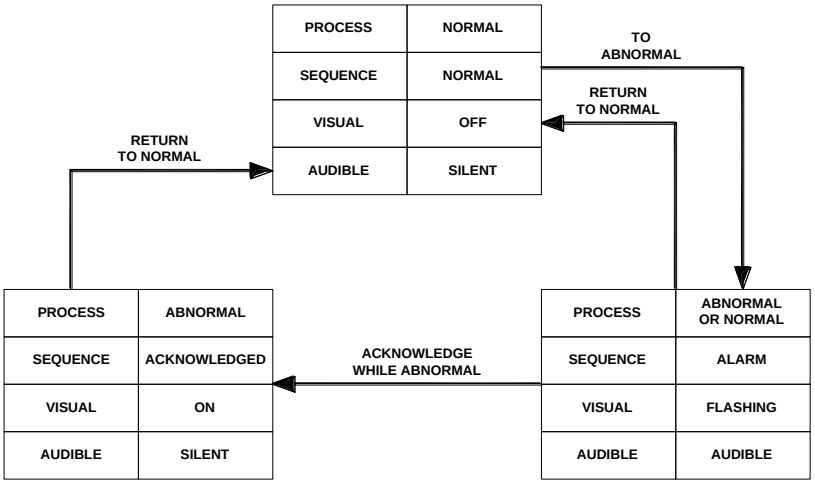
LINE	PROCESS CONDITION	PUSHBUTTON OPERATION	SEQUENCE STATE	VISUAL DISPLAY	ALARM AUDIBLE DEVICE	REMARKS
1	NORMAL		NORMAL	OFF	SILENT	
2	ABNORMAL		ALARM	FLASHING	AUDIBLE	LOCK-IN
3A	ABNORMAL	ACKNOWLEDGE	ACKNOWLEDGED	ON	SILENT	MAINTAINED ALARM
3B	NORMAL	ACKNOWLEDGE	TO LINE 4			MOMENTARY ALARM
4	NORMAL		NORMAL	OFF	SILENT	AUTOMATIC RESET

SEQUENCE FEATURES

1. ACKNOWLEDGE AND TEST PUSHBUTTONS
2. ALARM AUDIBLE DEVICE
3. LOCK-IN OF MOMENTARY ALARMS UNTIL ACKNOWLEDGED
4. THE AUDIBLE DEVICE IS SILENCED AND FLASHING STOPS WHEN ACKNOWLEDGED
5. AUTOMATIC RESET OF ACKNOWLEDGED ALARM INDICATIONS WHEN PROCESS CONDITIONS RETURN TO NORMAL
6. OPERATION TEST

10.3 **ISA-A-4 Sequence** - Non Lock-In Function

SEQUENCE DIAGRAM



SEQUENCE ISA A - 4
(NON LOCK IN)

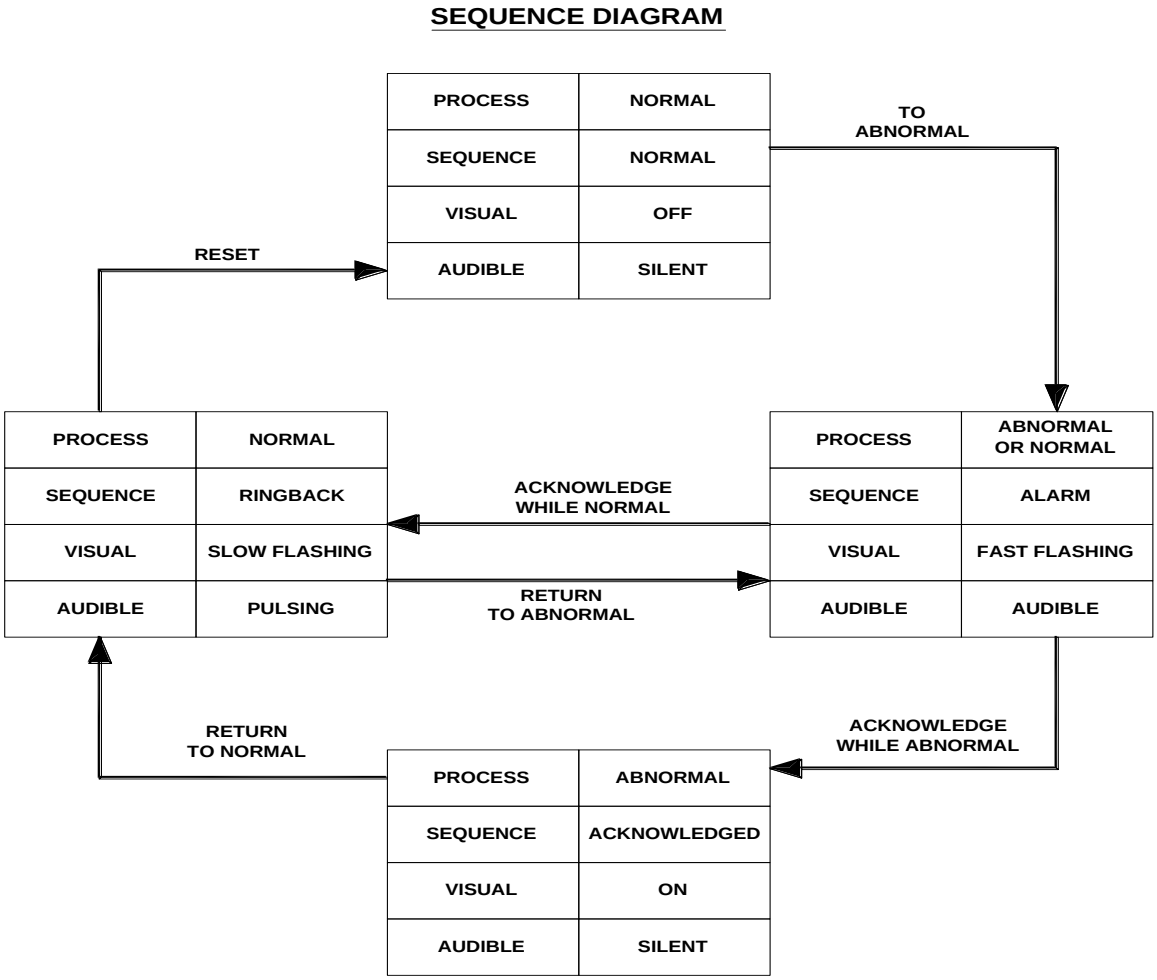
SEQUENCE TABLE

LINE	PROCESS CONDITION	PUSHBUTTON OPERATION	SEQUENCE STATE	VISUAL DISPLAY	ALARM AUDIBLE DEVICE	REMARKS
1	NORMAL		NORMAL	OFF	SILENT	
2	ABNORMAL		ALARM	FLASHING	AUDIBLE	
3	RETURN TO NORMAL BEFORE ACKNOWLEDGE		NORMAL	OFF	SILENT	NON LOCK IN
4	ABNORMAL	ACKNOWLEDGE	ACKNOWLEDGED	ON	SILENT	MAINTAINED ALARM
6	NORMAL		NORMAL	OFF	SILENT	AUTOMATIC RESET

SEQUENCE FEATURES

1. ACKNOWLEDGE AND TEST PUSHBUTTONS
2. ALARM AUDIBLE DEVICE
3. NON LOCK-IN OF MOMENTARY ALARMS
4. THE AUDIBLE DEVICE IS SILENCED AND FLASHING STOPS WHEN ACKNOWLEDGED
5. AUTOMATIC RESET OF ALARM INDICATIONS WHEN PROCESS CONDITIONS RETURN TO NORMAL BEFORE OR AFTER ACKNOWLEDGE (NON LOCK-IN)
6. OPERATION TEST

10.4 ISA-R Sequence - Ringback



SEQUENCE ISA R
(RING BACK)

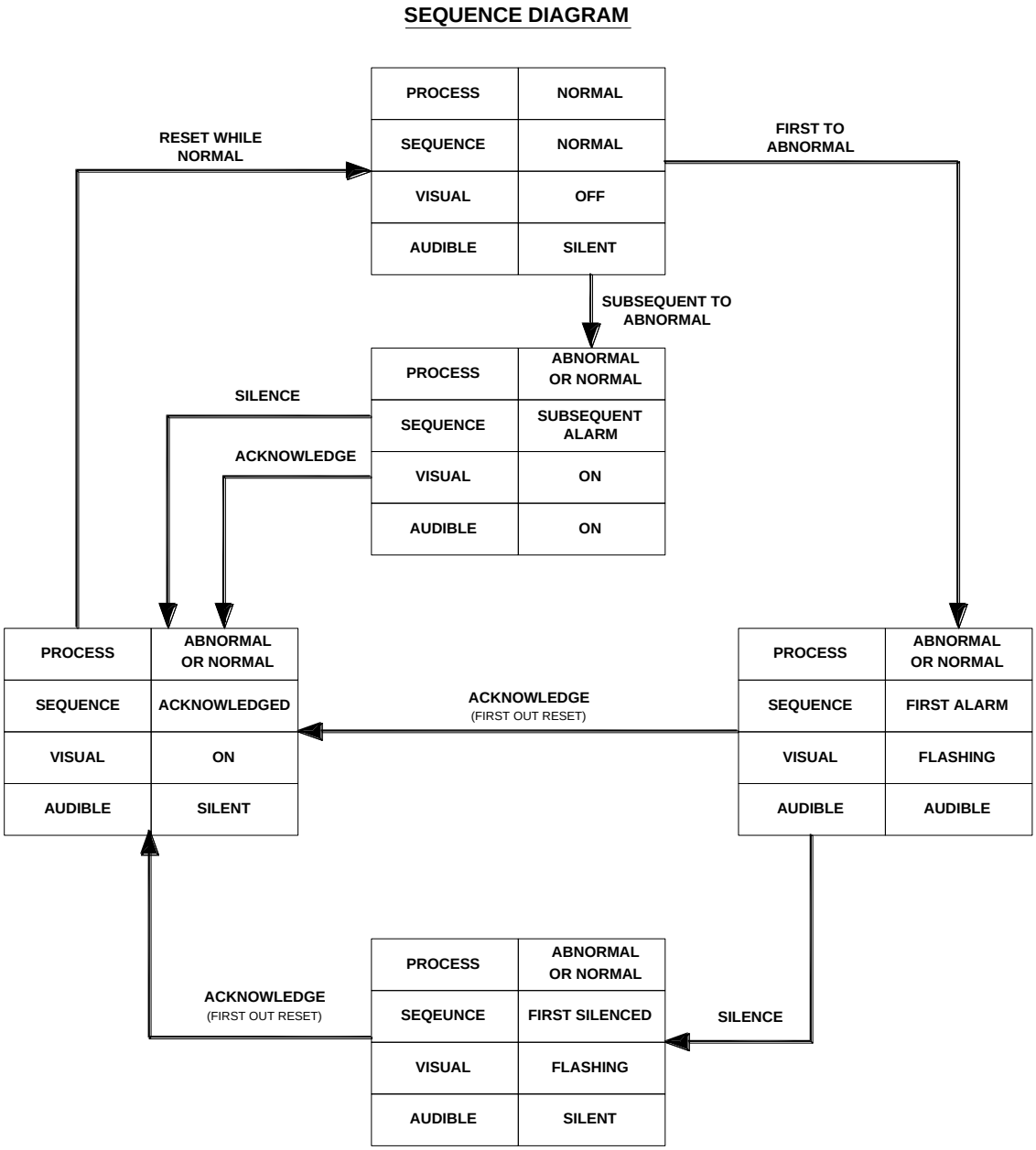
SEQUENCE TABLE

LINE	PROCESS CONDITION	PUSHBUTTON OPERATION	SEQUENCE STATE	VISUAL DISPLAY	ALARM AUDIBLE DEVICE	REMARKS
1	NORMAL		NORMAL	OFF	SILENT	
2	ABNORMAL		ALARM	FAST FLASHING	AUDIBLE	LOCK-IN
3A	ABNORMAL	ACKNOWLEDGE	ACKNOWLEDGED	ON	SILENT	MAINTAINED ALARM
3B	NORMAL	ACKNOWLEDGE	TO LINE 4			MOMENTARY ALARM
4	NORMAL		RINGBACK	SLOW FLASHING	SILENT	MANUAL RESET REQUIRED
5	ABNORMAL		TO LINE 2			RETURN TO NORMAL
6	NORMAL	RESET	NORMAL	OFF	SILENT	MANUAL RESET

SEQUENCE FEATURES

1. ACKNOWLEDGE, RESET AND TEST PUSHBUTTONS
2. ALARM AUDIBLE DEVICE (OPTIONAL RINGBACK AUDIBLE DEVICE)
3. LOCK-IN OF MOMENTARY ALARMS UNTIL ACKNOWLEDGED
4. THE AUDIBLE DEVICE IS SILENCED AND FLASHING STOPS WHEN ACKNOWLEDGED
5. RINGBACK VISUAL AND AUDIBLE INDICATIONS WHEN PROCESS CONDITIONS RETURN TO NORMAL.
6. MANUAL RESET OF RINGBACK INDICATIONS
7. OPERATION TEST

10.5 ISA-F2M-1 Sequence - Manual Reset First-Up



SEQUENCE ISA F2M-1

(MANUAL RESET FIRST OUT WITH NO SUBSEQUENT ALARM FLASHING & SILENCED PUSHBUTTON)

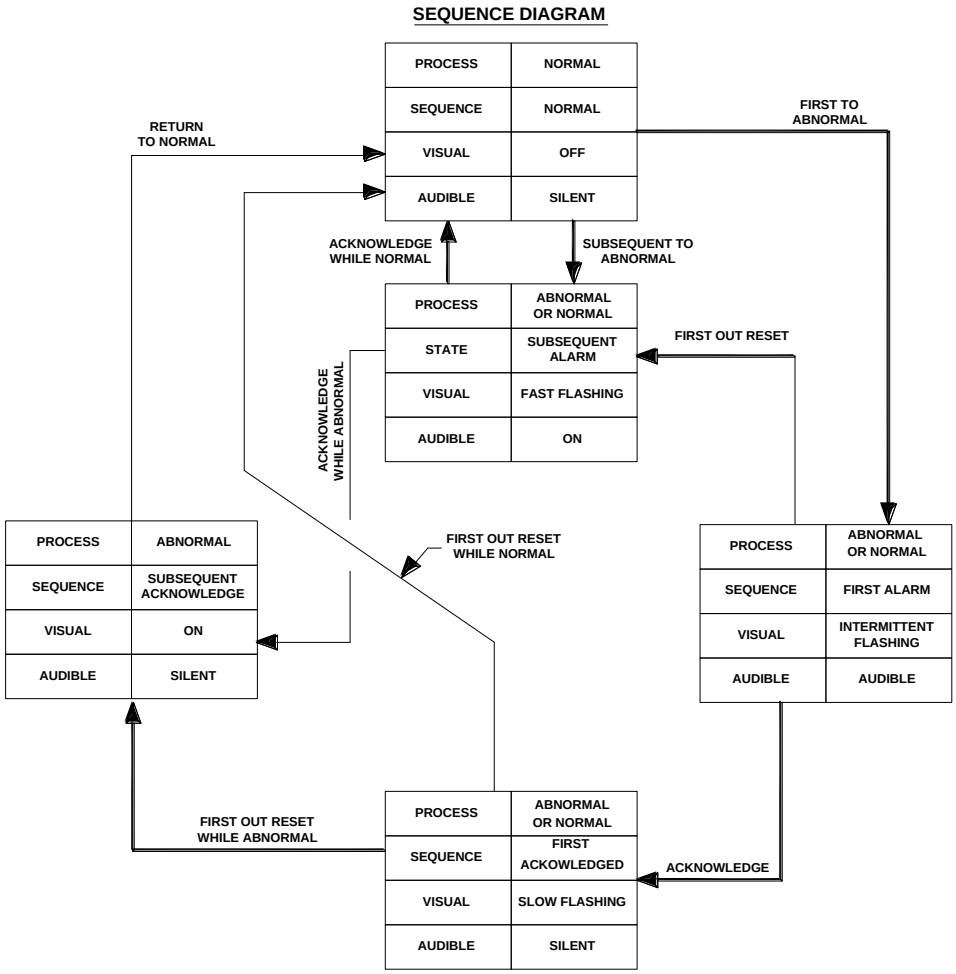
SEQUENCE TABLE

LINE	PROCESS CONDITION		PUSHBUTTON OPERATION	SEQUENCE STATE	VISUAL DISPLAY	ALARM AUDIBLE DEVICE	REMARKS
1	NORMAL			NORMAL	OFF	SILENT	
2	FIRST	ABNORMAL		FIRST ALARM	FLASHING	AUDIBLE	LOCK-IN
3	SUB.	ABNORMAL		SUB. ALARM	ON	AUDIBLE	LOCK-IN
4	FIRST	ABNORMAL OR NORMAL	ACKNOWLEDGE BEFORE SIL	TO LINE 7			FIRST OUT RESET
5	SUB.	ABNORMAL OR NORMAL					
6	FIRST	ABNORMAL OR NORMAL	SILENCE	FIRST SILENCED	FLASHING	SILENT	
7	SUB.	ABNORMAL OR NORMAL	SILENCE	ACKNOWLEDGE	ON	SILENT	MANUAL RESET REQUIRED
8	FIRST	ABNORMAL OR NORMAL	ACKNOWLEDGE AFTER SILENCE	TO LINE 7			FIRST OUT RESET
9	NORMAL		RESET	NORMAL	OFF	SILENT	MANUAL RESET

SEQUENCE FEATURES

1. SILENCE, ACKNOWLEDGE, RESET AND TEST PUSHBUTTONS
2. ALARM AUDIBLE DEVICE
3. LOCK-IN OF MOMENTARY ALARMS UNTIL ACKNOWLEDGED.
4. OPTION1 – SILENCE PUSHBUTTON TO SILENCE THE ALARM AUDIBLE DEVICE WHILE RETAINING THE FIRST OUT FLASHING INDICATION
5. FLASHING INDICATION FOR FIRST ALARM ONLY. NEW SUBSEQUENT ALARMS HAVE THE SAME VISUAL INDICATION AS ACKNOWLEDGED ALARMS.
6. FIRST OUT INDICATION IS RESET WHEN ACKNOWLEDGED
7. MANUAL RESET OF ACKNOWLEDGED ALARM INDICATIONS AFTER PROCESS CONDITIONS RETURN TO NORMAL.
8. OPERATIONAL TEST

10.6 ISA-F3A Sequence - Automatic Reset First-Up



SEQUENCE ISA F3A

(AUTOMATIC RESET FIRST OUT WITHOUT FLASHING & RESET PUSHBUTTON)

SEQUENCE TABLE

LINE	PROCESS CONDITION		PUSHBUTTON OPERATION	SEQUENCE STATE	VISUAL DISPLAY	ALARM AUDIBLE DEVICE	REMARKS
1	NORMAL			NORMAL	OFF	SILENT	
2	FIRST	ABNORMAL		FIRST ALARM	INTERMITTENT FLASHING	AUDIBLE	LOCK-IN
3	SUB.	ABNORMAL		SUB. ALARM	FAST FLASHING	AUDIBLE	LOCK-IN
4	FIRST	ABNORMAL OR NORMAL	FIRST OUT RESET BEFORE ACKNOWLEDGE	TO LINE 3			FIRST OUT RESET
5	FIRST	ABNORMAL OR NORMAL	ACKNOWLEDGE	FIRST ACKNOWLEDGED	SLOW FLASHING	SILENT	FIRST OUT RESET REQUIRED
6A	SUB.	ABNORMAL		SUB. ACKNOWLEDGE	ON	SILENT	MAINTAINED ALARM
6B	SUB.	NORMAL		TO LINE 8			MOMENTARY ALARM
7A	FIRST	ABNORMAL	FIRST OUT RESET AFTER ACKNOWLEDGE	TO LINE 6A			FIRST OUT RESET
7B	FIRST	NORMAL		TO LINE 8			FIRST OUT RESET
8	NORMAL			NORMAL	OFF	SILENT	AUTOMATIC RESET

SEQUENCE FEATURES

1. SILENCE, ACKNOWLEDGE, RESET AND TEST PUSHBUTTONS
2. ALARM AUDIBLE DEVICE
3. LOCK-IN OF MOMENTARY ALARMS UNTIL ACKNOWLEDGED.
4. OPTION1 – SILENCE PUSHBUTTON TO SILENCE THE ALARM AUDIBLE DEVICE WHILE RETAINING THE FIRST OUT FLASHING INDICATION
5. FLASHING INDICATION FOR FIRST ALARM ONLY. NEW SUBSEQUENT ALARMS HAVE THE SAME VISUAL INDICATION AS ACKNOWLEDGED ALARMS.
6. FIRST OUT INDICATION IS RESET WHEN ACKNOWLEDGED
7. MANUAL RESET OF ACKNOWLEDGED ALARM INDICATIONS AFTER PROCESS CONDITIONS RETURN TO NORMAL.
8. OPERATIONAL TEST

11. Options

11.1 General

The SIL725 Series alarm annunciator is designed to meet the majority of alarm specifications but in certain applications additional options may be required.

Please consult factory if you would like to check suitability of adding options to existing units.

11.2 LED Assemblies

Fit and forget LED assemblies are available in the following colours Red, Amber, Yellow, White, Blue or Green.

Please note all alarm cards are equipped with dual function output drives allowing the standard card to be used with either conventional filament lamps or LED's. SIL725 annunciators are not available with filament lamps thus this function must be set to LED's.

Switch SW1-8 on each card must be selected to OFF for the SIL Safety Annunciator version

FUNCTION	SW1-8
Outputs suitable for driving LED's	OFF

11.3 Tropicalisation

Standard on all SIL725 Annunciators

11.4 Individual Channel Repeat Relays (Option RLY)

As an option each dual channel alarm card within the annunciator can be supplied with two relays to allow a repeat signal from each channel to be sent to third party devices as required.

Whilst this feature is available it is important to note that these relays are not safety related relays and have not been considered as part of the product certification and therefore they should not be used as part of the safety function.

The non alarm coil state of each relay can be set to be either:-

FEATURE	FUNCTION	SETTING
Normally energised	F2	OFF
Normally de-energised	F2	ON

The operation mode of each relay can be selected to be either:-

Input Follower

The individual relay will activate when an alarm occurs and automatically return to normal when the signal input returns to the normal state.

FEATURE	FUNCTION	SETTING
Input follower	F18	OFF
	F19	ON

Logic Follower
The individual relay will activate when an alarm occurs and only return to normal when the signal input has returned to the normal state and the logic has reset, this may require the operator to press the associated pushbuttons to reset the alarm depending on the sequence selected.

FEATURE	FUNCTION	SETTING
Logic follower	F18	ON
	F19	OFF

Display Follower
The individual relay will activate when an alarm occurs and faithfully mimic the state of the output drive to the associated lamp (flashing, on or off)

FEATURE	FUNCTION	SETTING
Display follower	F18	ON
	F19	ON

Please note:- The Repeat Relay option should be specified at the time of ordering.

11.5 Customer Specified Response Time (Option CRT**)
The response time for standard units is factory set at 35ms.

If alternative response times are required, option CRT is used to specify a fixed response time, between 1ms and 2 seconds.

11.6 Customer Adjustable Response Time (Option AD*)
If specified at the time of order each channel can be supplied with a trim pot that allows the user to adjust the response time between two set points as required.
AD1 = 5ms to 50ms, AD2 = 35ms to 2 seconds or AD3 = 5ms to 5 seconds.

The trim pot is marked with 10 increments, each increment is worth 10% of the maximum delay time. For best results customers should always choose the most appropriate AD option for their application. i.e. the AD option which gives the most adjustment around the required response time.

Please note: When setting activation delays it is important to note that the same delay will apply to the return to normal state, for example:- If a channel is set for 5 Seconds delay the input contact must be in the abnormal state for a minimum of 5 Seconds before the alarm activates. Once the input contact has returned to normal the channel will not recognise the return to normal state for a minimum of 5 Seconds and therefore the channel cannot be reset until this delay has elapsed.

On P725 annunciators supplied after March 2009 where either AD2 or AD3 option is requested. Each channel is equipped with a switch, (SW2), which allows the user to select if

- *The return to normal state should have the same delay as the alarm activation.*
- *The return to normal state as soon as the input returns to normal.*

When using AD options the user must use SW2 to set the normally open or normally closed input state as detailed in chapter 21 of this manual. Function F1 should be set to OFF when using SW2 as described in Section 24 of this manual.*

Please note:- The CRT, and AD option should be specified at the time of ordering.

11.7 SPD Module (Supply-Pushbutton Module)

All Series SIL725 annunciators are equipped with 24VDC Logic. If external AC/DC or DC/DC Power supplies are required they should be capable of handling the maximum surge current, which is typically twice the maximum load when all LED windows are on steady.

11.8 Logic Power Connections

In standard applications a power supply with a single 24VDC output can be wired to the 24VDC logic power by connecting to terminals 0V and +V on the rear of the SPD Module.

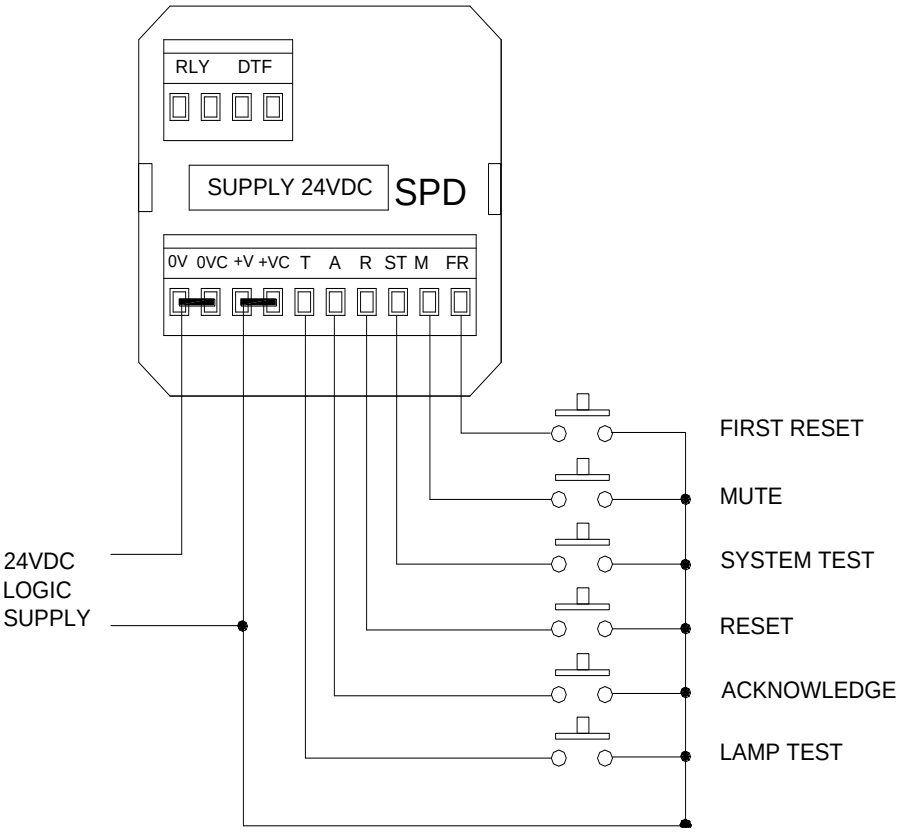
11.9 Signal Supply Voltage Connections

In standard applications the logic supply terminals 0V and +V can be cross-linked to the signal supply input terminals 0VC and +VC on the SPD module to provide +24VDC to distribute to the associated field contacts. (0V links to 0VC and +V links to +VC)

11.10 Power & Remote P.B. Connections

Customer connections for the common functions should be wired to the rear of the SPD module. These connections are shown below: -

COMMON CONNECTIONS	
24VDC Logic power (0V & +V)	**24VDC Signal contact voltage** (0VC & +VC)
	Optional remote pushbutton inputs
	T = Lamp test **A** = Acknowledge **R** = Reset **ST** = System test **M** = Mute **FR** = First reset Pushbutton common connection = +V



12. Large Window Alarm Module Wiring

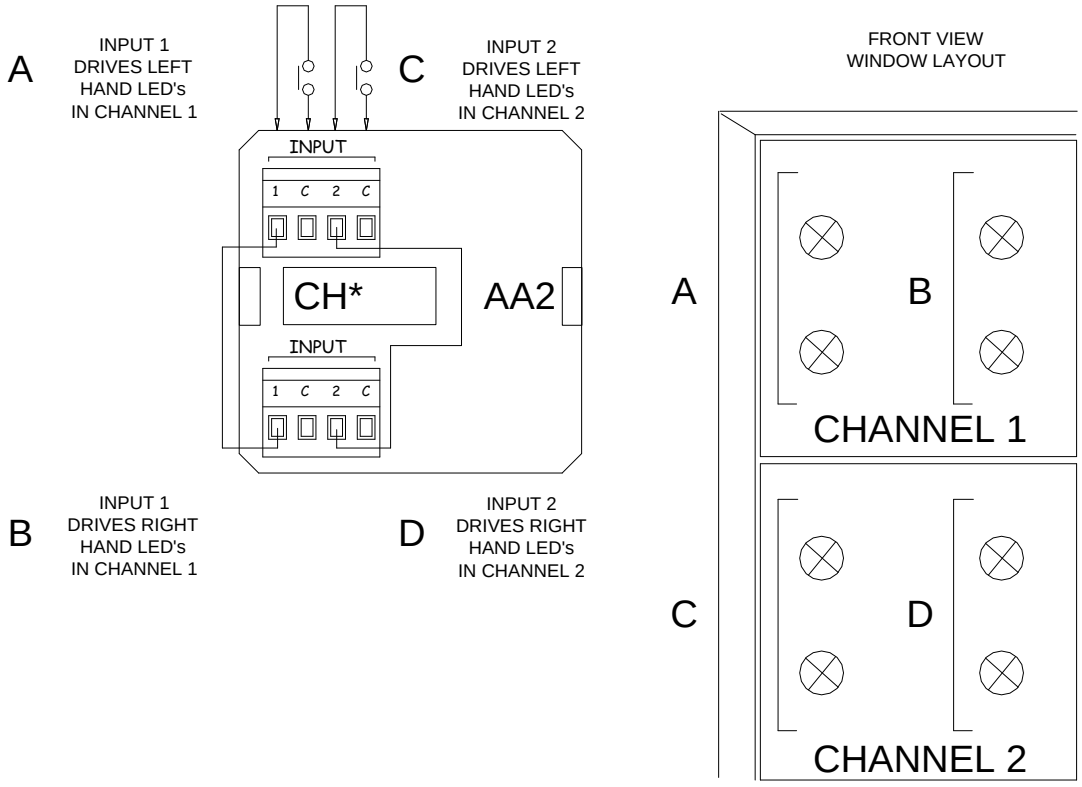
SIL725 Safety Annunciators supplied with large windows provide one alarm per cell.

12.1 Standard Unit without Repeat Relay Facility

Each cell is equipped with a type AA2 back plate and 2 x dual channel alarm cards.

Model CB5674SIL1 located in the upper slot and CB5674SIL3 located in the lower slot

Wiring Details for AA2 Modules in Large Window Versions

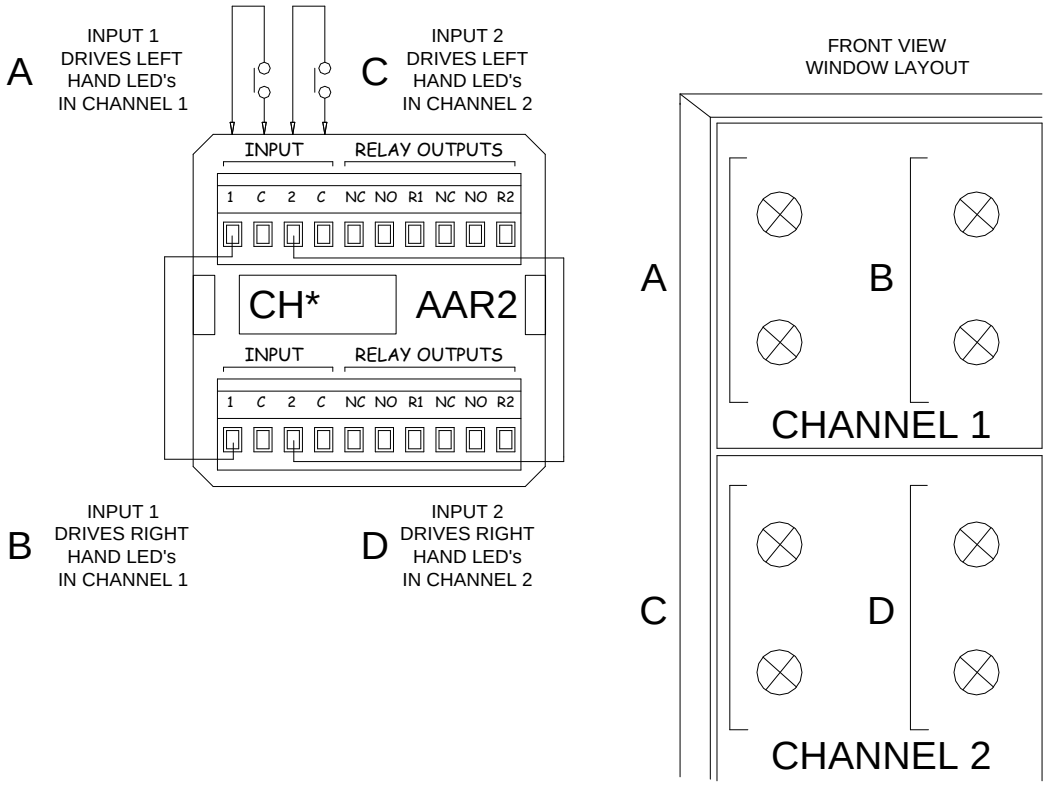


12.2 Optional Unit with Repeat Relay Facility

Each cell is equipped with a type AAR2 back plate and 2 x dual channel alarm cards

Model CB5674SIL2 located in the upper slot and CB5674SIL4 located in the lower slot

Wiring Details for AAR2 Modules in Large Window Versions



13. Medium Window Alarm Module Wiring

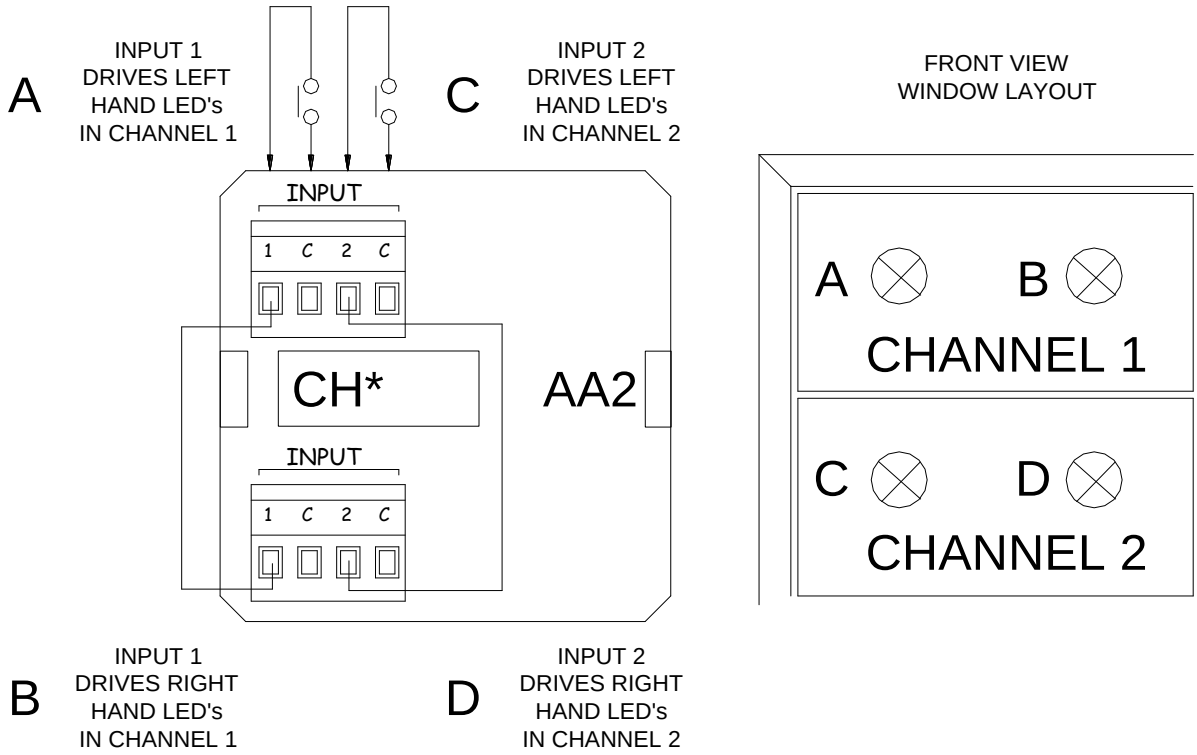
SIL725 Safety Annunciators supplied with medium windows provide two alarms per cell.

13.1 Standard Version without Repeat Relay Facility

Each cell is equipped with a type AA2 back plate and 2 x dual channel alarm cards.

Model CB5674SIL1 located in the upper slot and CB5674SIL3 located in the lower slot

Wiring Details for AA2 Medium Window Versions

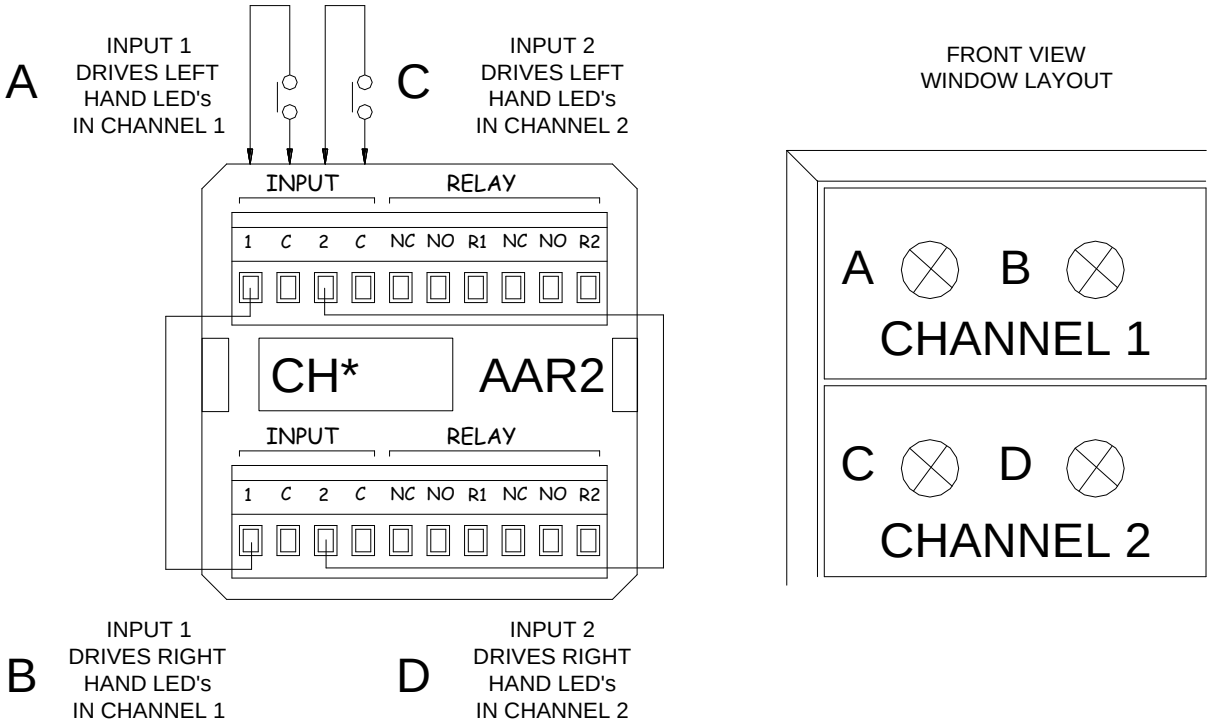


Wiring Details for AAR2 Medium Window Versions

13.2 Optional Version with Repeat Relay Facility

Each cell is equipped with a type AAR2 back plate 2 x dual channel alarm cards.

Model CB5674SIL2 located in the upper slot and CB5674SIL4 located in the lower slot

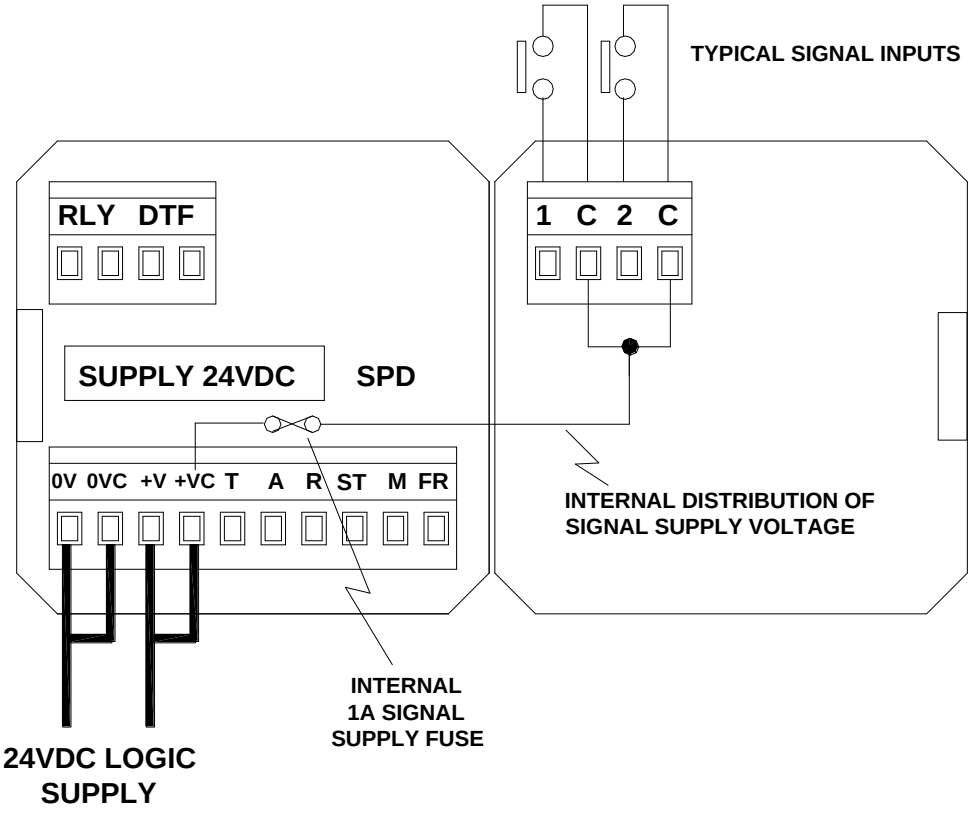


14. Standard Systems with Combined Logic and Signal Supply

In standard systems the 24VDC logic supply, 0V and +V is cross-linked to the signal supply input terminals, 0VC and +VC to provide the voltage required to power the input contacts. Systems are supplied with a factory fitted jumper between these terminals.

The signal supply input terminal +VC is used to internally link 24VDC Via a fuse to all of the common terminals within the annunciator marked “C” ready for connection to customer signal contacts

Systems Using A Single 24VDC For Logic And Signal Supply


TYPICAL SIGNAL INPUTS
RLY DTF
1 C 2 C
SUPPLY 24VDC
SPD
0V 0VC +V +VC T A R ST M FR
INTERNAL DISTRIBUTION OF SIGNAL SUPPLY VOLTAGE
INTERNAL 1A SIGNAL SUPPLY FUSE
24VDC LOGIC SUPPLY

Earthing

All SIL safety annunciators are fitted with a separate earth stud, which is located on the metal frame extrusion.

Warning: - To ensure the final installation meets all relevant safety standards and EMC directives this earth must be connected

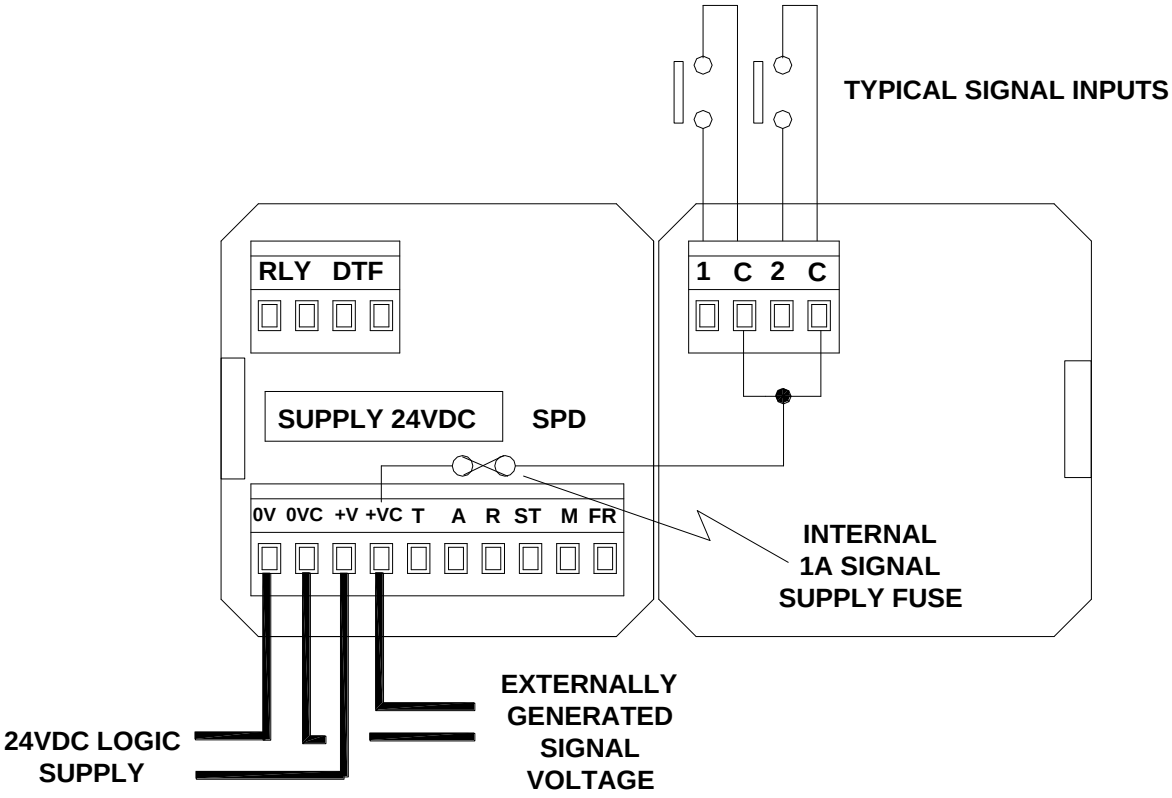
14.1 Standard Systems Using Externally Powered Inputs

As an option systems can use externally generated signal supply voltage sources to power the inputs.

If the externally generated signal supply voltage is 24VAC/DC then the standard annunciator can be used without modification.

The external supply should be connected to signal supply input terminals, 0VC and +VC to distribute the voltage required to power the input contacts. +VC is used to internally link the externally generated signal supply voltage, via a fuse, to all of the common terminals within the annunciator marked “C” to allow connection to customer signal contacts

Systems Using Isolated Logic and Signal Supplies

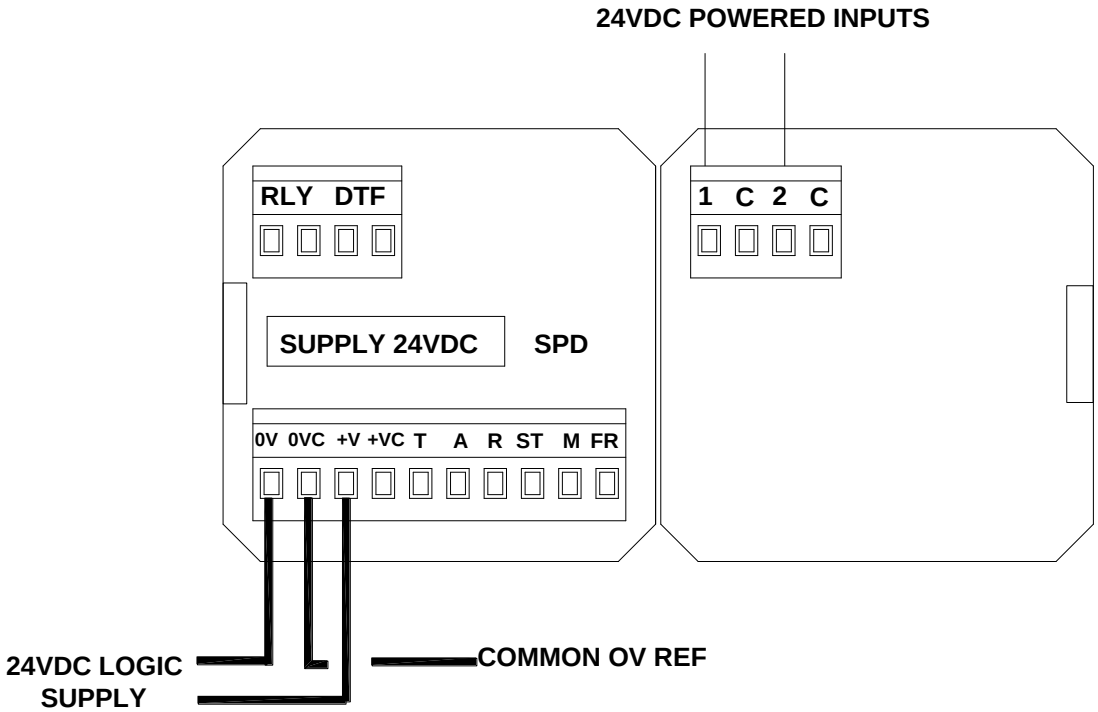


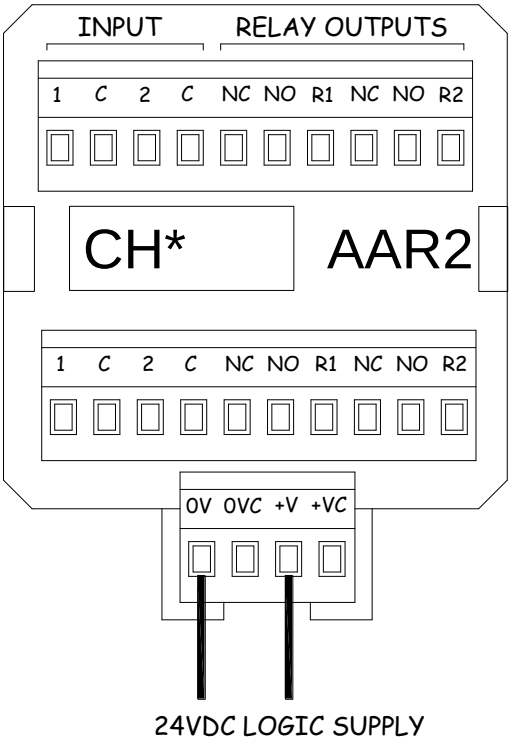
Systems Using Powered Inputs

In circumstances where the Annunciator is connected to equipment with volt sourcing outputs, there is need to use a common feed for signal supply.

If the powered output voltage is 24VAC / DC then the standard Annunciator can be used without modification.

The external 0V common is connected to 0VC and the powered outputs connect directly to the alarm input terminals.




INPUT
RELAY OUTPUTS
1 C 2 C NC NO R1 NC NO R2
CH*
AAR2
1 C 2 C NC NO R1 NC NO R2
0V 0VC +V +VC
24VDC LOGIC SUPPLY

15. SI/O Module Details

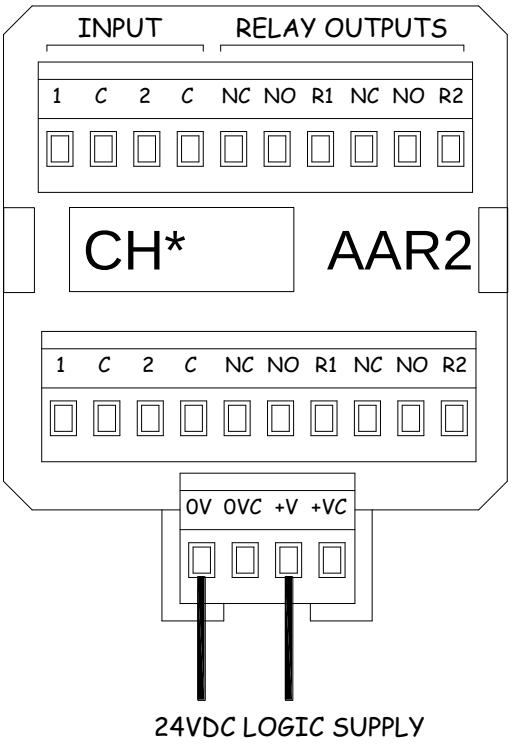
Larger units that require additional power distribution terminals are supplied with the optional SI/O card. The SI/O module is located in the bottom row of each annunciator in the system to provide the additional connections required for logic power distributions. Please note the SI/O card can be fitted in addition to any alarm cards already located within the cell.

Warning:-

A 24VDC supply should be independently connected to each annunciator unit within the scheme. Power should not be daisy chained between units, which would cause excessive current to flow within single units.

System sharing is not covered by the safety requirements specification, and is not supported for SIL725 annunciators.

Power Connections

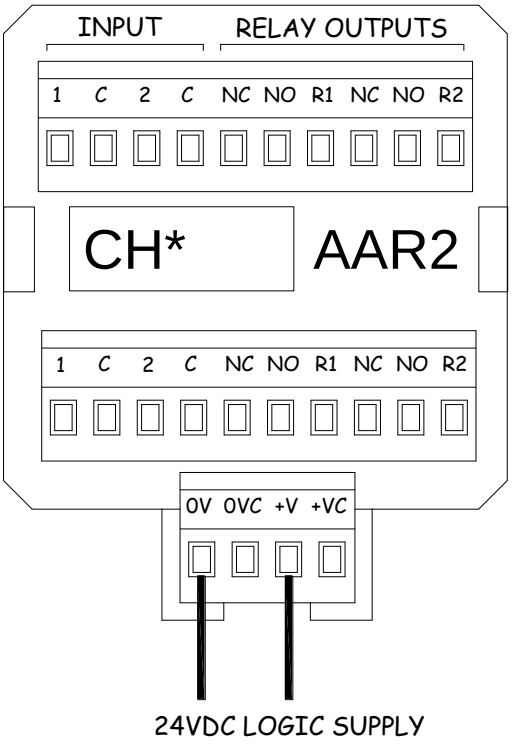


16. Power Distribution

Power Distribution on Large Annunciator Units

Systems greater than 48 cells are equipped with a minimum of one SI/O supply card to allow the user to distribute the logic supply load and avoid excessive current being passed through the motherboard. The first 48 cells in the annunciator are powered from the SPR module in the normal way. Each SI/O card is designed to power a maximum of 16 cells in larger applications multiple SI/O cards will therefore be present. With systems up to 62 cells the logic supply is factory wired between the SPR and SI/O cells however on systems over 62 cells it is necessary to power the SPR and SI/O cells using separate feed wires due to the higher currents required.

Typical SIO Module Wiring on AAR2 Type Alarm Module



Please Note:-
SI/O cards do not occupy the space of active alarm cards therefore units can be supplied fully populated.

17. System Configurations

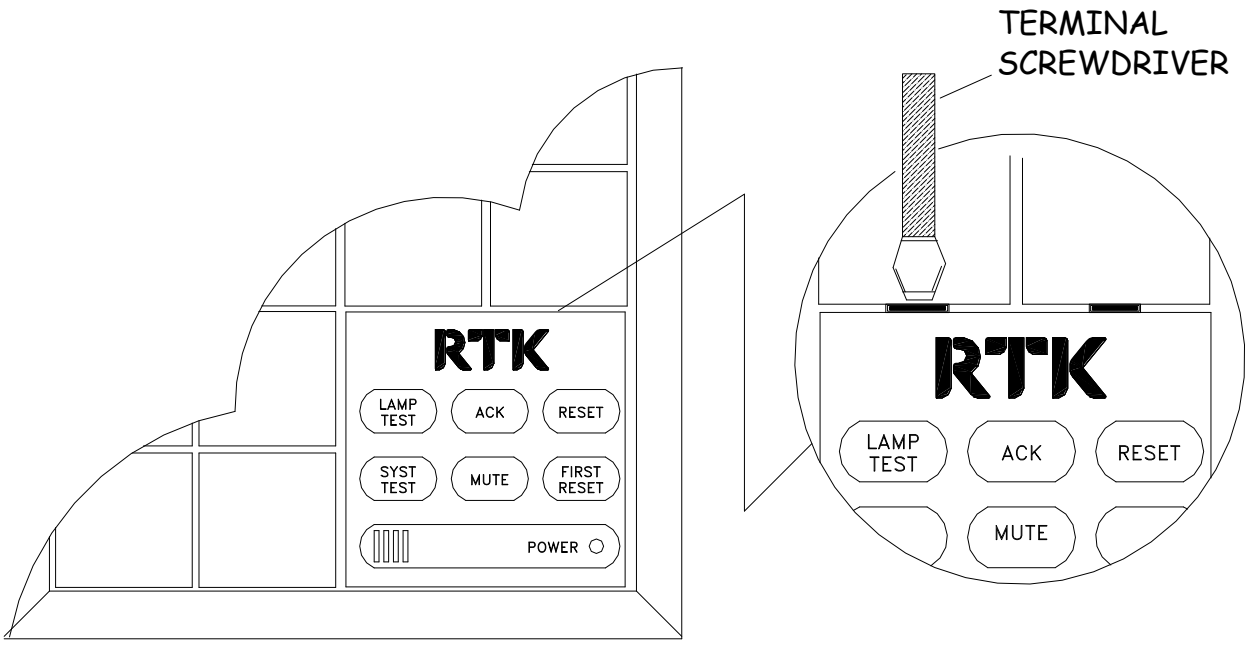
Functions

The SIL725 Annunciator is always supplied with a comprehensive range of pre-defined options which can be enabled or disabled on a channel by channel basis using the integral, (or as an option remote), pushbutton / configuration module. To simplify the configuration process each option has been allocated a unique “Function No.” between 1 and 24, any combination of these functions can be selected for each alarm way but care must be taken to ensure the operating modes selected do not conflict with each other. For example if ringback alarm sequence R is required the system should also be set to manual reset for the sequence to operate correctly. The key for functions 1 to 24 is shown later in the manual.

17.1 Configuration Mode

The configuration function of the unit is accessed by hinging down the pushbutton / configuration module using a small terminal screwdriver in the recess in the top of the bezel and levering forward the top edge of the assembly. This allows the assembly to hinge down to reveal the configuration information plate. To configure the unit, first place it in the configuration mode by moving the yellow switch to the “CONF” position, the "function" display will indicate 0 to confirm that the unit can be set.

Removal of the Pushbutton/Configuration Module

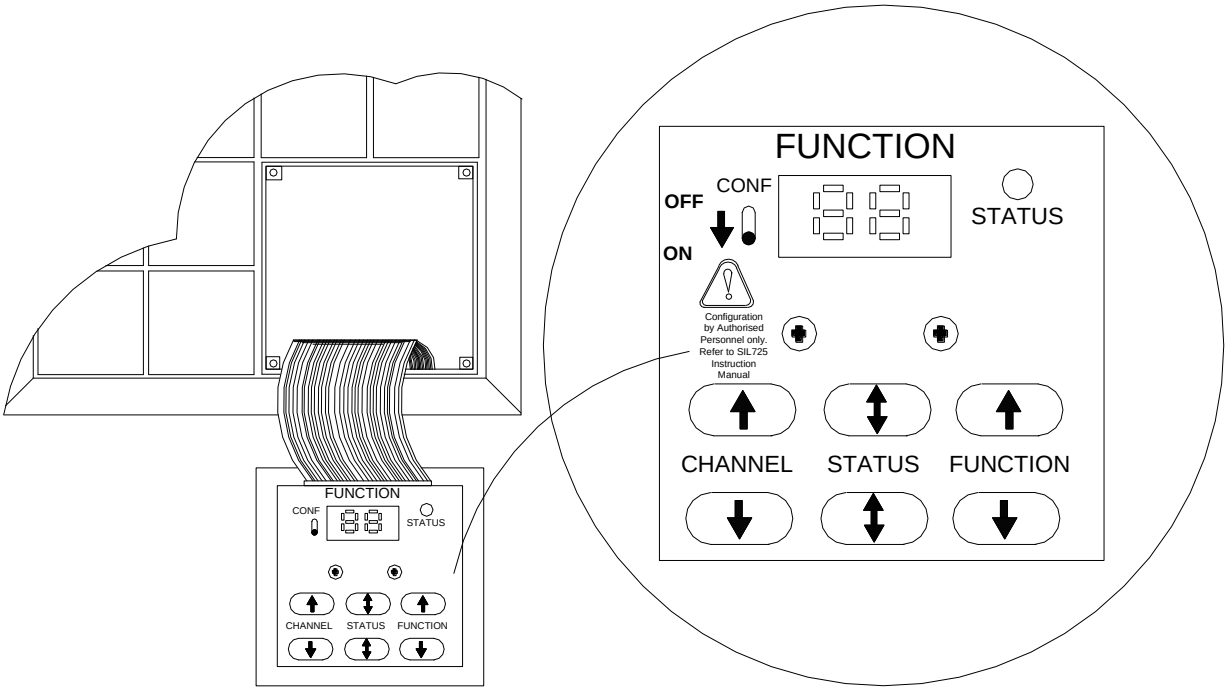


17.2 Changing a Function Setting

Please note: Configuration of a SIL725 Annunciator should only be carried out by authorised personnel using the SIL725 Instruction Manual.

When the pushbutton / Configuration module has been hinged down and the “CONF”, “programme mode”, switch has been placed to the ON position the operation of the pushbuttons changes as indicated on the information plate on the underside of the unit as detailed below:-

Configuration Information Plate Details



Once the unit is in the (CONF), programme mode, the window associated with the channel selected for Configuration will fast flash.

1. The LAMP TEST / SYST TEST pushbuttons are used to select the required channel
2. The RESET / FIRST RESET pushbuttons are used to select the required Function No.
3. The ACK / MUTE pushbuttons are used to enable or disable the feature.

Note:- If the status LED is on the feature has been enabled.

Important note:-

If the user configures a channel as detailed above and simply returns the unit to the run mode by placing the CONF switch to the off position the information will not be stored. Configuration changes are only stored after the user has moved onto an adjacent channel, using the system test or lamp test pushbuttons, at that point the configuration is stored in EEPROM on the associated alarm card

17.3 Configuration Example

Example: - If channel 7 is currently set to manual reset but the user would like to change this to allow the window to automatically reset, (after acknowledge), the following procedure should be followed.

1. First hinge down the pushbutton module to access the Configuration plate.
2. Place the unit into (CONF), Configuration mode, using the yellow switch to the left of the display
3. Use FIRST RESET / RESET pushbuttons to select function 3 (reset function)
4. Use the SYST TEST / LAMP test pushbuttons to select channel 7 and note the associated window will fast flash.
5. Use the MUTE / ACK pushbuttons to enable function F3 which is confirmed when the status LED is on.
6. Scroll to the next channel up or down to store the required setting using the SYST TEST / LAMP TEST pushbuttons.
7. Return to normal operation by placing the CONF switch to the off state

17.4 Checking Configuration Settings

After all of the required functions have been set on the unit it is recommended that the user checks the configuration to avoid problems during the commissioning stage. This is a simple process that should only take a few minutes and is achieved by placing the unit into the “CONF” mode and scrolling through each channel noting that as each Function is selected the status LED is on if enabled or off if disabled. When functions such as F23 (HNA Horn Relay) are selected all windows selected to operate the relay are illuminated in a steady on state to help the user identify which alarms are within the horn group. Please note:- A window selected for Configuration automatically fast flashes therefore the window of the channel that is being configured cannot be viewed to determine status information. The status LED on the information plate can be used as an alternative to view the setting for this channel, if the status LED is on the function has been enabled, or the user can move to an adjacent channel to allow the alarm window to be used in the normal way.

17.5 Systems with Unarmed Ways

Each dual alarm card in the system is provided with a unique binary address, which is set using on board DIL switches during manufacturing. If the system has been supplied with unarmed ways the address normally used for the associated channels will be reserved to allow the user to add the card at a later date. The Configuration module is designed to stop navigating between channels when it detects a missing card address (normally the last card in the system). When the channel navigation stops because of unarmed ways it is necessary to “jump over” the missing address to access any further channels. To “jump” an address the user needs to hold down the reset pushbutton and then press and hold the "channel up or down" pushbutton.

17.6 Points to Note when Configuring

Alarm channels are always numbered in a standard format depending on window size and the channel up / down pushbuttons are used to move between each channel in the correct order.

Alarm channels ***MUST*** always be configured in pairs.

The selected feature is only stored when the user selects an adjacent channel (either going up or down). After the Configuration is complete it is recommended that the user checks the required functions have been enabled correctly.

After Configuration it is recommended that any channels that have been changed are tested to ensure that the operation is in line with the required functions. The Configuration process includes an inbuilt comprehensive error checking routine. In applications where there is extreme electrical noise

this may result in the program not being accepted. If this happens, simply repeat the process for that particular alarm channel.

18. Function No Key and Descriptions

If units are supplied with unarmed alarm channels it is necessary to jump over these missing cards (addresses) to access the next channel.

General Description

The SIL725 is equipped with numerous pre-defined features that can be simply enabled or disabled on a per channel basis as required. Functions numbers are assigned to each feature for ease of selection.

Feature and Function Key

FEATURE	FUNCTION	STATUS LED	
		OFF	ON
Monitor current input contact state	FO	Alarm Contact Open	Alarm contact closed
Set signal contact non alarm state	F1	Normally Open	Normally closed
Set individual channel repeat Relay non alarm state	**F2**	Normally energised	Normally de-energised
Set automatic or manual Reset function	F3	Manual Reset	Automatic reset
Not Compatible	F4	Lock in	Non lock in
Set alarm to ringback sequence	F5	N/A	Ringback
Pushbutton interlock	F6	Enable	Disable
Input reflash	F7	Disable	Enable
Not Compatible	F8	Disable	Enable
Not Supported	F9	Disable	Enable
Set alarm to first up sequence F0	F10*	Disable	Enable
Not Compatible	F11	Disable	Enable
Set alarm to first up sequence F2	F12	Disable	Enable
Set alarm to first up sequence F3	F13	Disable	Enable
Set alarm to be in first up group A	F14*	Disable	Enable
Set alarm to be in first up group B	F15	Disable	Enable
Not Supported	F16	Disable	Enable
Not Supported	F17	Disable	Enable
Set repeat relays to follow logic	**F18**	Disable	Enable
Set repeat relays to follow input	**F19**	Disable	Enable
Set repeat relays to follow LED Windows	**F18 & F19**	Disable	Enable
Repeat relays inhibited on test	F20	Disable	Enable
Set alarm to GPA group relay	F21*	Disable	Enable
Set alarm to GPB group relay	F22*	Disable	Enable
Set alarm to HNA horn relay	F23*	Disable	Enable
Set alarm to HNB horn relay	F24*	Disable	Enable

NOTE:

1. The functions marked with the * are the default settings if no configuration is requested with the order
2. Functions F2, F18 & F19 are only available if individual channel repeat relays are fitted (Option RLY).
3. Functions F22 & F24 are only available if additional Safety relays (HNB and GPB) have been fitted.
4. Functions Labelled **Not Supported** are functions which if selected may not perform as intended, and therefore should never be enabled.
5. Functions Labelled **Not Compatible** are functions which should not be selected as they do not conform to the Safety Requirement Specification Rev 2.2 20/11/07

19. Function Descriptions

Function numbers are used to describe pre-defined features that can be enabled or disabled by the Customer as required.

F0- Contact Status

Function F0 allows each window in the annunciator to be illuminated if the associated signal contact is in the closed state. This is normally used to help the user identify the current state of the input device from the front of the unit without disturbing plant wiring.

F1- normally open (N/O) or normally closed (N/C) signal input contact

Each alarm input can be configured to allow operation from a N/O or N/C field contact. In SIL applications normally closed contacts should be used to provide fail safe operations

FEATURE-F1	STATUS LED
Set channel to operate from a normally open signal input contact	OFF
Set channel to operate from normally closed signal input contact	ON

When using Customer Adjustable Response Time option AD* Function F1 should be set to OFF and Switch SW2 located on each (2) channel alarm card should be used to set the inputs to normally closed as described later in the manual.

F2- Individual Channel Output Relay State

This feature is only available if individual channel repeat relays, option RLY, are fitted to the annunciator.

FEATURE-F2	STATUS LED
Set individual channel repeat relay to be normally energised in non alarm state	OFF
Set individual channel repeat relay to be normally de-energised in non alarm state	ON

F3- Manual Or Automatic Reset

Acknowledged alarms can be set to manual reset where the operator must press the reset pushbutton to clear the alarm after the input has returned to normal or acknowledged alarms can be set to automatic reset which allows the alarm to automatically clear as soon as the input returns to normal.

FEATURE-F3	STATUS LED
Set channel to manual reset	OFF
Set channel to automatic reset	ON

F4- Lock-In or Non-Lock-In Operation

Not a compatible with SIL725 annunciator.

F5- Ringback Sequence

Ringback sequence is used to inform the operator that an acknowledged alarm has returned to normal. When an acknowledged alarm returns to normal the associated window will slow flash to indicate to the operator that the alarm can be reset.

FEATURE-F5	STATUS LED
Set channel to ringback not required	OFF
Set channel to ringback sequence	ON

Please note:- Function F3, F4 must be set to the off state for ringback sequence to function correctly.

F6- Reset Pushbutton Optional Function

If required the reset pushbutton can be used for both acknowledge and reset.

FEATURE-F6	STATUS LED
Set channel to allow acknowledge & reset pushbuttons to operate independently	OFF
Set channel to allow the reset pushbutton to be used for acknowledge & reset	ON

F7- Input Reflash (Re-Alarm)

On Manual Reset Sequences Input reflash is used to inform the operator that an acknowledged alarm waiting to be Reset has returned to normal and re-alarmed.

FEATURE-F7	STATUS LED
Set Channel To Disable Input Reflash	OFF
Set Channel To Enable Input Reflash	ON

F8- Common Safety Relay Group-A Reflash Function

Not compatible with SIL725 Annunciators

F9- Common Safety Relay Group-B Reflash Function

Not supported on SIL725 Annunciators

F10- First-Up Sequence FO

This feature is used to enable first-up sequence FO on individual channels as required. F0 sequence will enable slow flash on subsequent alarms. Full sequence tables are provided in Section 10

FEATURE-F10	STATUS LED
Set channel to first-up sequence FO not required	OFF
Set channel to first-up sequence FO required	ON

F11- First-Up Sequence F1

Not compatible with SIL725 Annunciators

F12- First-Up Sequence F2

This feature is used to enable First-Up sequence F2 on individual channels as required. First up sequence F2 disables first out, all alarms will be seen as subsequent.

FEATURE-F12	STATUS LED
Set channel to first-up sequence F2 not required	OFF
Set channel to first-up sequence F2 required	ON

F13- First-Up Sequence F3

This feature is used to enable first-up sequence F3 on individual channels as required. First up sequence F3 Enables Fast Flash On subsequent alarms.

FEATURE-F13	STATUS LED
Set channel to first-up sequence F3 not required	OFF
Set channel to first-up sequence F3 required	ON

F14 - First-Up Group A

All alarms set to function F14 will operate as a single first-up group in accordance with the selected first-up sequence. F14 is the function code allocated for first-up Group A.

FEATURE-F14	STATUS LED
Set to remove channel from first-up Group A	OFF
Set to include channel in first-up Group A	ON

F15 - First-Up Group B

All alarms set to function F15 will operate as a single first-up group in accordance with the selected first-up sequence. F15 is the function code allocated for first-up Group B.

FEATURE-F15	**STATUS LED**
Set to remove channel from first-up Group B	OFF
Set to include channel in first-up Group B	ON

F16 - First-Up Group C

Not supported on SIL725 Annunciators

F17 - First-up Group D

Not supported on SIL725 Annunciators

F18- Individual Channel Repeat Relay (Follows Alarm Logic)

A relay set to function F18 will activate on alarm and remain in the alarm state until the alarm has returned to normal and the associated pushbuttons have been pressed. Please note:- The individual relay is activated by the alarm logic or when system test is pressed (See function F20).

FEATURE-F18	STATUS LED
Set Channel To Off If This Feature Is Not Required	OFF
Set Channel To Repeat Relay Follows Alarm Logic	ON

F19- Individual Channel Repeat Relay (Follows Signal Input)

A relay set to function F19 will activate when the signal input is in the alarm state and will automatically return to normal when the signal input returns to normal. Please note:- The individual relay is only activated by its signal input and never operates as a result of lamp or system test only

FEATURE-F19	STATUS LED
Set Channel To Off If This Feature Is Not Required	OFF
Set Channel To Repeat Relay Follows Signal Input	ON

F18 And 19- Individual Channel Repeat Relay (Follows Display)

A relay set to both function F18 and F19 will follow the alarm display. Please note:- The individual relay operates as a slave of the lamp output signal and when system test or lamp test is pressed. (The relay cannot be prevented from operating when lamp or system test are pressed (See function F20).

FEATURE-F18 AND F19	STATUS LED
Set Channel To Off If This Feature Is Not Required	OFF
Set Channel To Repeat Relay Follows Display	ON

F20- Inhibit Group Repeat Relays On System Test

If any channel in the system has been assigned to either the GPA or GPB relays using function F21 or F22 and system test is pressed the group relays will activate. However if function F20 is enabled the GPA and GPB relays cannot be triggered by system test.

FEATURE-F20	STATUS LED
Set Channel To Operate The GPA & GPB Relays On System Test	OFF
Set Channel To Inhibit The GPA & GPB Relays On System Test	ON

F21- Safety Group A (GPA) Relay

Each channel can be set to operate the Safety Group A relay using function F21. When set the alarm channel will activate the group relay when an alarm occurs and the relay will remain active until the alarm has returned to normal and the channel has been acknowledged and reset.

FEATURE-F21	STATUS LED
Remove channel from the safety group relay GPA	OFF
Set channel to operate the safety group relay GPA	ON

F22- Safety Group B (GPB) Relay (Optional)

Each channel can be set to operate Safety Group B relay using function F22. When set the alarm channel will activate the group relay when an alarm occurs and relay will remain active until the alarm has returned to normal and the channel has been acknowledged and reset.

FEATURE-F22	STATUS LED
Remove channel from the safety group relay GPB	OFF
Set channel to operate the safety group relay GPB	ON

F23- Safety Horn A (HNA) Relay

Each channel can be set to operate the safety horn relay using function F23. When set the alarm channel will activate the horn relay when an alarm occurs and the relay will remain active until the mute or acknowledge pushbutton has been pressed.

FEATURE-F23	STATUS LED
Remove channel from the safety horn relay HNA	OFF
Set channel to operate the safety horn relay HNA	ON

F24- Safety Horn B (HNB) Relay (optional)

Each channel can be set to operate the safety horn relay using function F24.
When set the alarm channel will activate the horn relay when an alarm occurs and the relay will remain active until the mute or acknowledge pushbutton has been pressed.

FEATURE-F24	STATUS LED
Remove channel from the safety horn relay HNB	OFF
Set channel to operate the safety horn relay HNB	ON

20. Alarm Card Address Settings

Dual Channel Alarm Card Address and Output Drive Type Settings

Before each card is placed within the annunciator a unique address No. has to be set using the switches located on DIL switch SW1, which allows the Configuration module to communicate and pass Configuration instructions to and from the associated alarm channels. When replacing an alarm card the switches on DIL Switch SW1 must be set to match the card that is being removed.

SW1-*	FUNCTION	ON	OFF
SW1-1	Set address Bit 1	1	0
SW1-2	Set address Bit 2	1	0
SW1-3	Set address Bit 3	1	0
SW1-4	Set address Bit 4	1	0
SW1-5	Set address Bit 5	1	0
SW1-6	Set address Bit 6	1	0
SW1-7	Set address Bit 7	1	0

21.1 Set Output Drive to Operate With LED's

As all SIL725 units are fitted LED's SW1-8 should always remain off.

SW1	Fit & forget LED assemblies	SW1-8	OFF

21.2 Alarm Card DIL Switch SW1 Address Settings

ADDRESS		64	32	16	8	4	2	1
NO.	BINARY	SW1-7	SW1-6	SW1-5	SW1-4	SW1-3	SW1-2	SW1-1
0	0000000	OFF	OFF	OFF	OFF	OFF	OFF	OFF
1	0000001	OFF	OFF	OFF	OFF	OFF	OFF	ON
2	0000010	OFF	OFF	OFF	OFF	OFF	ON	OFF
3	0000011	OFF	OFF	OFF	OFF	OFF	ON	ON
4	0000100	OFF	OFF	OFF	OFF	ON	OFF	OFF
5	0000101	OFF	OFF	OFF	OFF	ON	OFF	ON
6	0000110	OFF	OFF	OFF	OFF	ON	ON	OFF
7	0000111	OFF	OFF	OFF	OFF	ON	ON	ON
8	0001000	OFF	OFF	OFF	ON	OFF	OFF	OFF
9	0001001	OFF	OFF	OFF	ON	OFF	OFF	ON
10	0001010	OFF	OFF	OFF	ON	OFF	ON	OFF
11	0001011	OFF	OFF	OFF	ON	OFF	ON	ON
12	0001100	OFF	OFF	OFF	ON	ON	OFF	OFF
13	0001101	OFF	OFF	OFF	ON	ON	OFF	ON
14	0001110	OFF	OFF	OFF	ON	ON	ON	OFF
15	0001111	OFF	OFF	OFF	ON	ON	ON	ON
16	0010000	OFF	OFF	ON	OFF	OFF	OFF	OFF
17	0010001	OFF	OFF	ON	OFF	OFF	OFF	ON
18	0010010	OFF	OFF	ON	OFF	OFF	ON	OFF
19	0010011	OFF	OFF	ON	OFF	OFF	ON	ON
20	0010100	OFF	OFF	ON	OFF	ON	OFF	OFF
21	0010101	OFF	OFF	ON	OFF	ON	OFF	ON
22	0010110	OFF	OFF	ON	OFF	ON	ON	OFF
23	0010111	OFF	OFF	ON	OFF	ON	ON	ON
24	0011000	OFF	OFF	ON	ON	OFF	OFF	OFF
25	0011001	OFF	OFF	ON	ON	OFF	OFF	ON
26	0011010	OFF	OFF	ON	ON	OFF	ON	OFF
27	0011011	OFF	OFF	ON	ON	OFF	ON	ON
28	0011100	OFF	OFF	ON	ON	ON	OFF	OFF
29	0011101	OFF	OFF	ON	ON	ON	OFF	ON
30	0011110	OFF	OFF	ON	ON	ON	ON	OFF
31	0011111	OFF	OFF	ON	ON	ON	ON	ON
32	0100000	OFF	ON	OFF	OFF	OFF	OFF	OFF
33	0100001	OFF	ON	OFF	OFF	OFF	OFF	ON
34	0100010	OFF	ON	OFF	OFF	OFF	ON	OFF
35	0100011	OFF	ON	OFF	OFF	OFF	ON	ON
36	0100100	OFF	ON	OFF	OFF	ON	OFF	OFF
37	0100101	OFF	ON	OFF	OFF	ON	OFF	ON
38	0100110	OFF	ON	OFF	OFF	ON	ON	OFF
39	0100111	OFF	ON	OFF	OFF	ON	ON	ON
40	0101000	OFF	ON	OFF	ON	OFF	OFF	OFF

Alarm Card DIL Switch SW1 Address Settings 41 To 80

ADDRESS		64	32	16	8	4	2	1
NO.	BINARY	SW1-7	SW1-6	SW1-5	SW1-4	SW1-3	SW1-2	SW1-1
41	0101001	OFF	ON	OFF	ON	OFF	OFF	ON
42	0101010	OFF	ON	OFF	ON	OFF	ON	OFF
43	0101011	OFF	ON	OFF	ON	OFF	ON	ON
44	0101100	OFF	ON	OFF	ON	ON	OFF	OFF
45	0101101	OFF	ON	OFF	ON	ON	OFF	ON
46	0101110	OFF	ON	OFF	ON	ON	ON	OFF
47	0101111	OFF	ON	OFF	ON	ON	ON	ON
48	0110000	OFF	ON	ON	OFF	OFF	OFF	OFF
49	0110001	OFF	ON	ON	OFF	OFF	OFF	ON
50	0110010	OFF	ON	ON	OFF	OFF	ON	OFF
51	0110011	OFF	ON	ON	OFF	OFF	ON	ON
52	0110100	OFF	ON	ON	OFF	ON	OFF	OFF
53	0110101	OFF	ON	ON	OFF	ON	OFF	ON
54	0110110	OFF	ON	ON	OFF	ON	ON	OFF
55	0110111	OFF	ON	ON	OFF	ON	ON	ON
56	0111000	OFF	ON	ON	ON	OFF	OFF	OFF
57	0111001	OFF	ON	ON	ON	OFF	OFF	ON
58	0111010	OFF	ON	ON	ON	OFF	ON	OFF
59	0111011	OFF	ON	ON	ON	OFF	ON	ON
60	0111100	OFF	ON	ON	ON	ON	OFF	OFF
61	0111101	OFF	ON	ON	ON	ON	OFF	ON
62	0111110	OFF	ON	ON	ON	ON	ON	OFF
63	0111011	OFF	ON	ON	ON	OFF	ON	ON
64	1000000	ON	OFF	OFF	OFF	OFF	OFF	OFF
65	1000001	ON	OFF	OFF	OFF	OFF	OFF	ON
66	1000010	ON	OFF	OFF	OFF	OFF	ON	OFF
67	1000011	ON	OFF	OFF	OFF	OFF	ON	ON
68	1000100	ON	OFF	OFF	OFF	ON	OFF	OFF
69	1000101	ON	OFF	OFF	OFF	ON	OFF	ON
70	1000110	ON	OFF	OFF	OFF	ON	ON	OFF
71	1000111	ON	OFF	OFF	OFF	ON	ON	ON
72	1001000	ON	OFF	OFF	ON	OFF	OFF	OFF
73	1001001	ON	OFF	OFF	ON	OFF	OFF	ON
74	1001010	ON	OFF	OFF	ON	OFF	ON	OFF
75	1001011	ON	OFF	OFF	ON	OFF	ON	ON
76	1001100	ON	OFF	OFF	ON	ON	OFF	OFF
77	1001101	ON	OFF	OFF	ON	ON	OFF	ON
78	1001110	ON	OFF	OFF	ON	ON	ON	OFF
79	1001111	ON	OFF	OFF	ON	ON	ON	ON
80	1010000	ON	OFF	ON	OFF	OFF	OFF	OFF

Alarm Card DIL Switch SW1 Address Settings 81 To 120

ADDRESS		64	32	16	8	4	2	1
NO.	BINARY	SW1-7	SW1-6	SW1-5	SW1-4	SW1-3	SW1-2	SW1-1
81	1010001	ON	OFF	ON	OFF	OFF	OFF	ON
82	1010010	ON	OFF	ON	OFF	OFF	ON	OFF
83	1010011	ON	OFF	ON	OFF	OFF	ON	ON
84	1010100	ON	OFF	ON	OFF	ON	OFF	OFF
85	1010101	ON	OFF	ON	OFF	ON	OFF	ON
86	1010110	ON	OFF	ON	OFF	ON	ON	OFF
87	1010111	ON	OFF	ON	OFF	ON	ON	ON
88	1011000	ON	OFF	ON	ON	OFF	OFF	OFF
89	1011001	ON	OFF	ON	ON	OFF	OFF	ON
90	1011010	ON	OFF	ON	ON	OFF	ON	OFF
91	1011011	ON	OFF	ON	ON	OFF	ON	ON
92	1011100	ON	OFF	ON	ON	ON	OFF	OFF
93	1011101	ON	OFF	ON	ON	ON	OFF	ON
94	1011110	ON	OFF	ON	ON	ON	ON	OFF
95	1011111	ON	OFF	ON	ON	ON	ON	ON
96	1100000	ON	ON	OFF	OFF	OFF	OFF	OFF
97	1100001	ON	ON	OFF	OFF	OFF	OFF	ON
98	1100010	ON	ON	OFF	OFF	OFF	ON	OFF
99	1100011	ON	ON	OFF	OFF	OFF	ON	ON
100	1100100	ON	ON	OFF	OFF	ON	OFF	OFF
101	1100101	ON	ON	OFF	OFF	ON	OFF	ON
102	1100110	ON	ON	OFF	OFF	ON	ON	OFF
103	1100111	ON	ON	OFF	OFF	ON	ON	ON
104	1101000	ON	ON	OFF	ON	OFF	OFF	OFF
105	1101001	ON	ON	OFF	ON	OFF	OFF	ON
106	1101010	ON	ON	OFF	ON	OFF	ON	OFF
107	1101011	ON	ON	OFF	ON	OFF	ON	ON
108	1101100	ON	ON	OFF	ON	OFF	OFF	OFF
109	1101101	ON	ON	OFF	ON	ON	OFF	ON
110	1101110	ON	ON	OFF	ON	ON	ON	OFF
111	1101111	ON	ON	OFF	ON	ON	ON	ON
112	1110000	ON	ON	ON	OFF	OFF	OFF	OFF
113	1110001	ON	ON	ON	OFF	OFF	OFF	ON
114	1110010	ON	ON	ON	OFF	OFF	ON	OFF
115	1110011	ON	ON	ON	OFF	OFF	ON	ON
116	1110100	ON	ON	OFF	ON	OFF	OFF	OFF
117	1110101	ON	ON	ON	OFF	ON	OFF	ON
118	1110110	ON	ON	ON	OFF	ON	ON	OFF
119	1110111	ON	ON	ON	OFF	ON	ON	ON
120	1111000	ON	ON	ON	ON	OFF	OFF	OFF

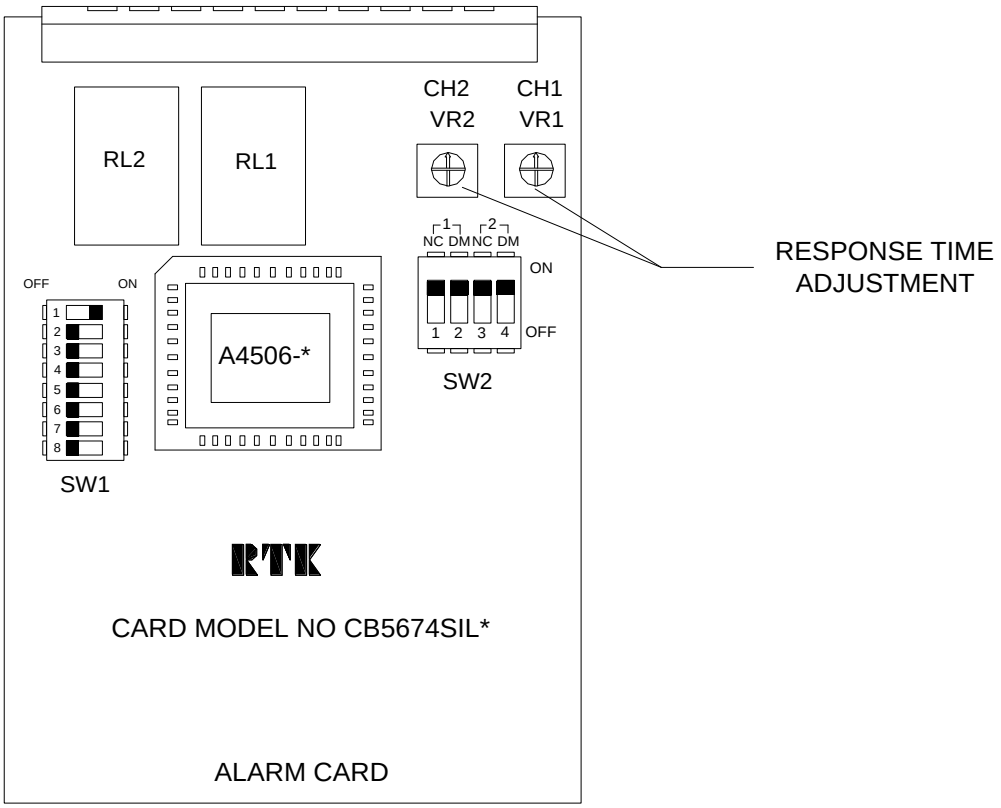
Alarm Card DIL Switch SW1 Address Settings 121 To 127

ADDRESS		64	32	16	8	4	2	1
NO.	BINARY	SW1-7	SW1-6	SW1-5	SW1-4	SW1-3	SW1-2	SW1-1
121	1111001	ON	ON	ON	ON	OFF	OFF	ON
122	1111010	ON	ON	ON	ON	OFF	ON	OFF
123	1111011	ON	ON	ON	ON	OFF	ON	ON
124	1111100	ON	ON	ON	ON	ON	OFF	OFF
125	1111101	ON	ON	ON	ON	ON	OFF	ON
126	1111110	ON	ON	ON	ON	ON	ON	OFF
127	1111111	ON	ON	ON	ON	ON	ON	ON

21. Adjustable Response Times

If specified at the time of order alarm cards can be supplied with single-turn potentiometers that allows the user to set the reponse time of each input. Three time ranges are available:-

1. Option AD1 = 5 – 50 ms
2. Option AD2 = 20ms - 2 seconds
3. Option AD3 = 5ms – 5 seconds



To access the individual alarm card the plastic cover plate on the rear of the associated cell must be removed by squeezing the lock-in tabs on either side of the cover.

The alarm card can then be removed to allow adjustments to be made to VR1 (Channel 1) and VR2 (Channel 2) as required.

Turn the trim pot in a clockwise direction to increase the response time.

Return to Normal Delay Period

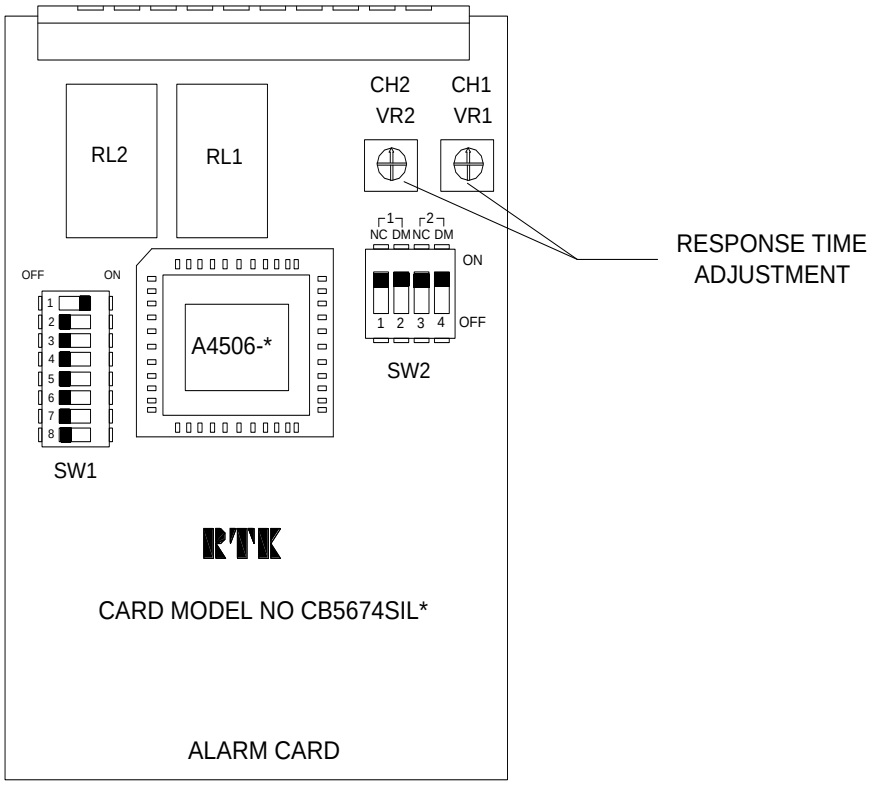
In standard applications any delay period set for alarm initiation is also applied to the return to normal state.

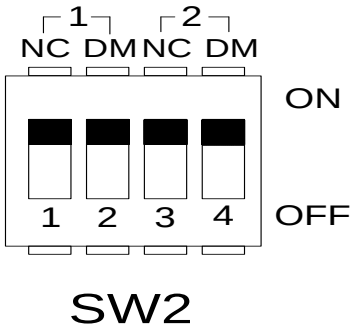
For example if a 5 second delay is set, the alarm will not activate until the input has been in the abnormal state for a minimum of 5 seconds.

If the alarm returns to normal the same delay period of 5 seconds will apply before the alarm state returns to normal.

In some applications customers prefer the alarm to have a delay before the alarm activates but as soon as the input returns to normal they require the alarm to return to the non alarm condition. Switch SW2 on the alarm card the Delay Mode will activate a fast return to normal when switched on.

- SW2 – 1 & 3 are used to set the Input state to Normally Open (N/O) or Normally Closed (N/C). ***On SIL units these switches will always be on, so the input state remains N/C***
- SW2 – 2 & 4 are used to set the Delay Mode
- When the Delay Mode (DM) switch is off the delay for an input going active is the same as it is when the input goes from active to inactive. The time is set by VR1, and VR2.
- When the DM switch is set, the delay for input going to active is set by VR1, and VR2. When the input is going inactive from active the delay will be the minimum time response for that AD option.





SW2

Input State

When using AD* options Function F1 should be set to OFF and Switch SW2 located on each (2) channel alarm card should be used to set the inputs to normally closed as shown below

Switch No	Function	Default Setting	Description
SW2-1	Ch-1 input state	On	Set the channel input state. On SIL725 units the default is normally closed.
SW2-2	Ch-1 Delay Mode	Off	Set the channel return (active to non active) response time. If switched on the return response will always be minimum response for that AD option. The default is off.
SW2-3	Ch-2 input state	On	Set the channel input state. On SIL725 units the default is normally closed.
SW2-4	Ch-2 Delay Mode	Off	Set the channel return (active to non active) response time. If switched on the return response will always be minimum response for that AD option. The default is off.

22. Safety Calculations

22.1 What is in this chapter

To comply with IEC 61508 and/or related standards, the user needs to show that the failure rate of each safety function meets the safety target for the risk being protected.

Each safety function must be considered separately, as each safety function, in general, protects a separate risk.

A safety function must be considered as the complete system, from the input device that senses something about the process, through the equipment that evaluates and processes the information (the *logic solver*), to the output device that takes some action on the process in response to a demand.

The SIL725 may act as the logic solver to a number of safety functions.

This chapter gives the failure rate data for the SIL725 that the user needs to calculate the failure rate and probability of failure on demand for each safety function.

The user is responsible for the correct and appropriate use of this information in his particular application.

This information is intended for competent persons with an appropriate knowledge of safety engineering and IEC 61508.

22.2 Modes of operation

The SIL725 has two input channels on each active alarm card, so that each cell has effectively 2 inputs.

Each input may be configured to one of four group safety relay outputs, HNA, HNB, GPA or GPB.

Consequently, each safety relay output may be driven by one, two or several inputs and may be part of one or more than one safety function.

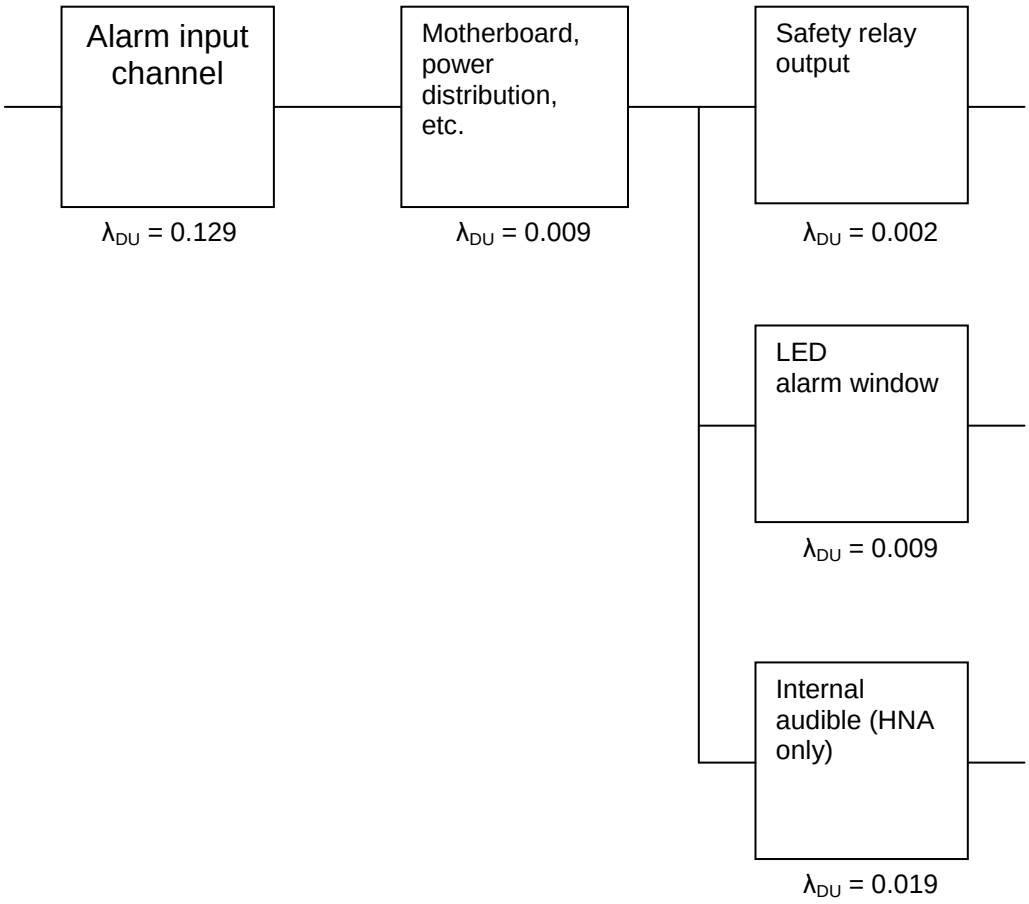
A single safety function uses one or more inputs, some common parts of the SIL725 including the motherboard and power distribution, one or more LED alarm windows and a safety output relay.

The HNA group also uses the internal audible too.

Consequently, the failure rates for each safety function depend on the configuration used.

The following sections show how the failure rates are derived for 1oo1 and 1oo2 configurations, and provide sufficient information for the user to derive failure rates for any configuration.

22.3 Single channel 1oo1



The above figure shows the reliability block diagram for a 1oo1 safety function, that is where a single input through a single alarm input channel is used. There are three outputs that might be used as part of a safety function, these are:

The safety group relay output, GPA, GPB, HNA, or HNB
The LED alarm window
For HNA only, the internal audible

The *dangerous undetected* failure rate, λ_{DU}, for each block is shown, in units of failures per million hours (pmh).

A *dangerous undetected* failure is defined as a failure that prevents the safety function from asserting in response to a demand at the input. That is, a *dangerous undetected* failure prevents either

the safety group relay from de-energising, or
the LED alarm window from illuminating, or
for HNA only, the internal audible from sounding,

If all of these outputs are included as part of the safety function, then the total *dangerous undetected* failure rate is the sum of the individual total *dangerous undetected* failure rates shown, 0.17 pmh, or 1.7×10^{-7} failures per hour.

Some dangerous failures of the alarm input card are detected by internal diagnosics. Such faults are known as *dangerous detected*. If a fault is detected, the diagnostic relay is de-energised. The diagnostic relay contacts can be configured to either assert the safety function, or to assert a diagnostic alarm calling for maintenance. The contacts must be configured to one or other of these options.

Other failure modes may either have no effect on the safety function, or they will cause the safety function to assert without a demand being present. Together they are classed as *safe undetected* failures.

The SIL725 has no *safe detected* failures.

Failures that cause the safety function to assert without a demand being present are often known as a *spurious trip*.

The following table lists all the failure rates for the 1oo1 configuration.

	λ_{DU}	λ_{DD}	$\lambda_{SPURIOUS}$	λ_{SU}
Alarm input channel	0.129	0.019	0.081	0.333
Motherboard, power distribution etc.	0.009	0	0.027	0.096
Safety relay output	0.002	0	2.415	4.242
LED alarm window	0.009	0	0.002	0.009
Internal audible (HNA only)	0.019	0	0.008	0.020
Total	0.168	0.019	2.533	4.70

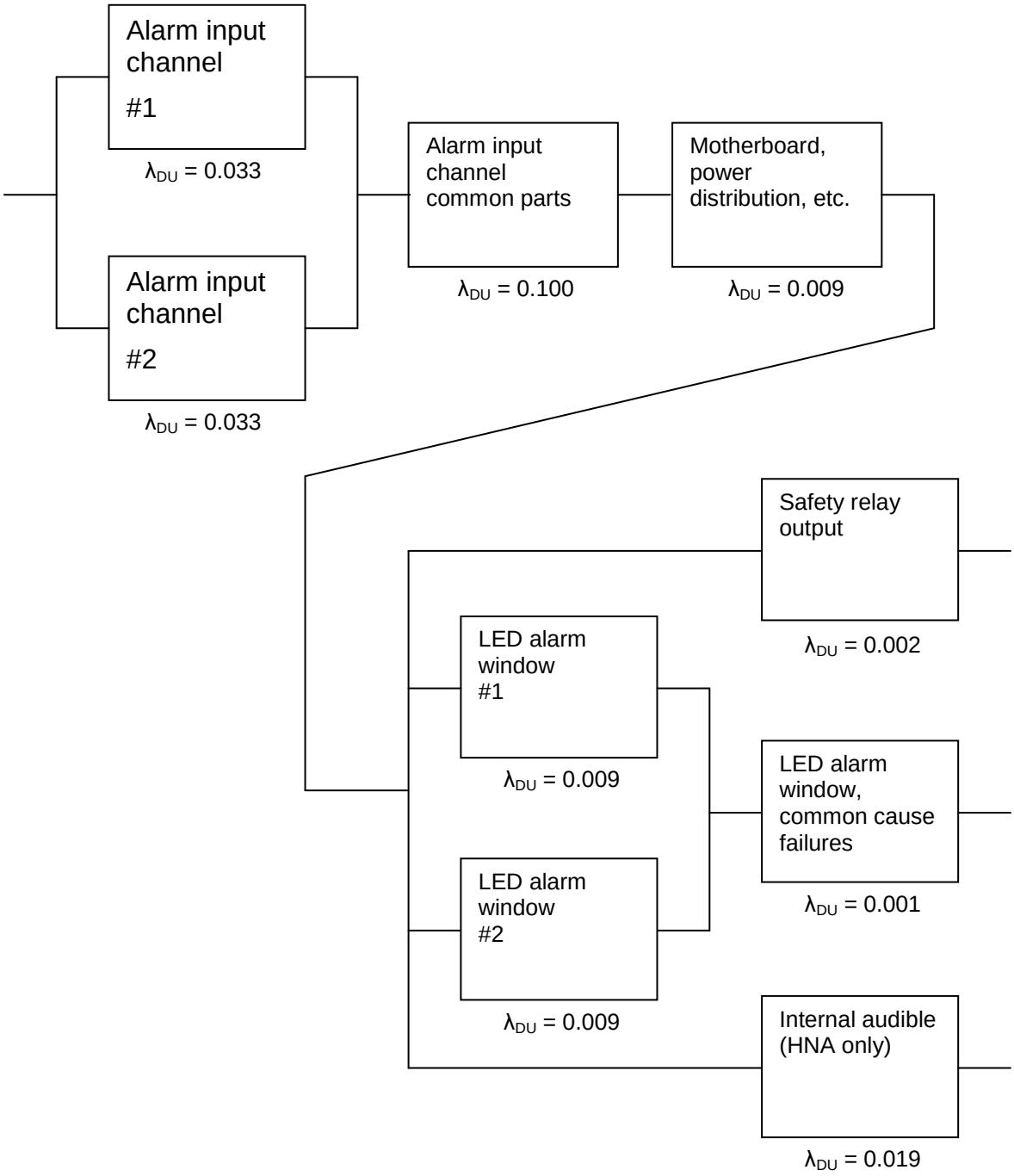
All failure rates are given in units of failures per million hours (pmh). The failure rates are defined as:

- λ_{DU} – *dangerous undetected* failure rate : Failures that can prevent the safety function being asserted on demand that are not detected by internal diagnostics.
- λ_{DD} – *dangerous detected* failure rate : Failures that can prevent the safety function being asserted on demand that are detected by internal diagnostics.
- $\lambda_{SPURIOUS}$ – *spurious* failure rate : Failures that cause the safety function to assert without a demand being present.
- λ_{SU} – *safe undetected* failure rate : Failures that either cause the safety function to assert without a demand being present or have no effect on the safety function. (λ_{SU} includes $\lambda_{SPURIOUS}$)

22.4 Two channel, 1oo2 on the same input card

The following figure shows the reliability block diagram for a 1oo2 safety function, in which two inputs are fed into the two channels of a single alarm input card. The two inputs may be connected to a single input device or, where higher integrity is required, to two input devices monitoring the same process condition.

Each two-input alarm input card contains some circuitry that is independent, and some that is



common to the two input channels. The failure rate shown for 'Alarm input channel common parts'

includes both the failure rate of those parts plus an allowance for common cause failures in the input channels.

Since each input channel is associated with a separate LED alarm window, the reliability block diagram shows these in parallel, with an allowance for common cause failures. It is assumed that *either* LED alarm window illuminating is sufficient as an alarm.

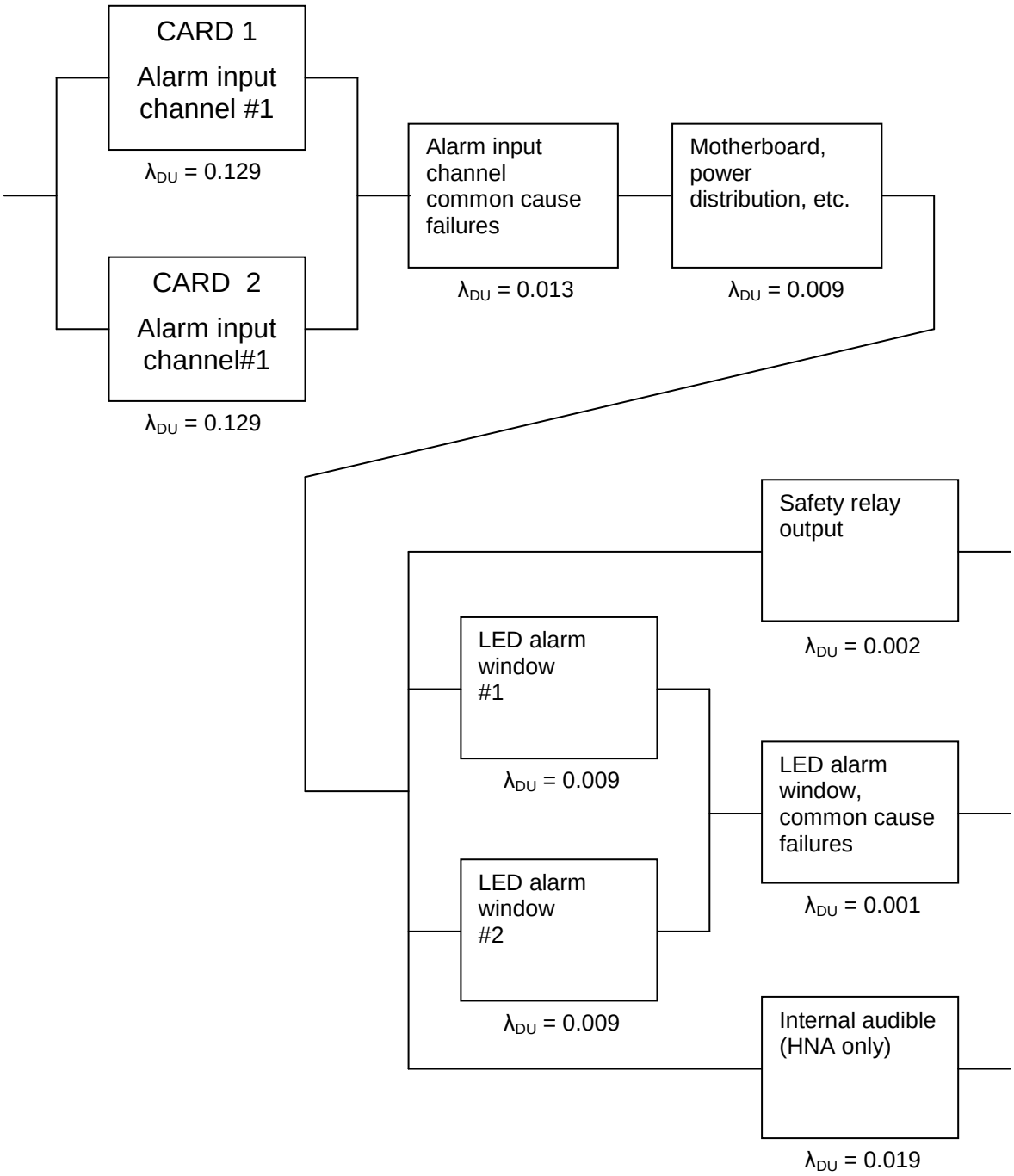
The failure rate of a safety function implemented as 1oo2 cannot be calculated by simply adding failure rates, in a similar manner to the 1oo1 safety function. Section 6 shows how to calculate the *probability of failure on demand* for 1oo1 and 1oo2 safety functions.

The following table lists all the failure rates for the 1oo2 configuration, using the same input card.

	λ_{DU}	λ_{DD}	$\lambda_{SPURIOUS}$	λ_{SU}
Alarm input channel #1	0.033	0	0.034	0.101
Alarm input channel #2	0.033	0	0.034	0.101
Alarm input channel common parts	0.100	0.019	0.046	0.229
Motherboard, power distribution etc.	0.009	0	0.027	0.096
Safety relay output	0.002	0	2.415	4.242
LED alarm window #1	0.009	0	0.002	0.009
LED alarm window #2	0.009	0	0.002	0.009
LED alarm window, common cause	0.001	0	0	0
Internal audible (HNA only)	0.019	0	0.008	0.020
Total	-	0.019	2.568	4.807

22.5 Two channel, 1oo2 on the different input cards

The following figure shows the reliability block diagram for a 1oo2 safety function, in which two inputs are fed into two, separate alarm input cards. This is very similar to the previous case, with the subtle difference that there are no common parts shared between the two input channels. The *dangerous undetected* failure rate for each alarm input channel is therefore the same as for single channel, 1oo1. An allowance is made for common cause failures that might cause both alarm input cards to fail in the same manner.



The following table lists all the failure rates for the 1oo2 configuration, using different input cards.

	λ_{DU}	λ_{DD}	$\lambda_{SPURIOUS}$	λ_{SU}
Alarm input channel #1	0.129	0.019	0.081	0.333
Alarm input channel #2	0.129	0.019	0.081	0.333
Alarm input channel common parts	0.013	0.002	-	-
Motherboard, power distribution etc.	0.009	0	0.027	0.096
Safety relay output	0.002	0	2.415	4.242
LED alarm window #1	0.009	0	0.002	0.009
LED alarm window #2	0.009	0	0.002	0.009
LED alarm window, common cause	0.001	0	0	0
Internal audible (HNA only)	0.019	0	0.008	0.020
Total	-	0.040	2.616	5.042

22.6 Calculation of Probabilty of Failure on Demand

When a safety function is used in an *on demand* mode, the safety reliability is expressed as an *average probability of failure on demand,* or *PFD*. This is the probability that the safety function will not perform if a demand occurs, perhaps because a failure has caused it to be stuck in its normal state.

The PFD depends on the *dangerous undetected* failure rate together with the *proof test interval*. A *proof test* checks that the safety function is working correctly, and so the more frequently a proof test is carried out, the lower the probability that the safety function will have failed when a demand occurs.

The following paragraphs describe a way of calculating the PFD for the configurations shown in the preceding sections. It must be understood that this is given for guidance only and is not intended as a cookbook method of designing safety functions. Safety systems should be designed by competent staff with the necessary knowledge, in accordance with the principles of IEC61508, local regulations, and site-specific requirements.

22.7 Proof tests

There are two proof tests possible with the SIL725. At intervals of generally a year or more, a full test should be carried out to verify the correct operation of all safety functions. This will generally involve the SIL725 being taken off-line, and so could conveniently be carried out during a planned maintenance shutdown. Alternatively, temporary measures could be put in place to safeguard the operation of the process while the SIL725 is taken off-line, so that the process can continue uninterrupted.

Pressing ‘lamp test’ will cause all LED alarm windows to illuminate and the internal audible to sound. None of the output relays will change state. This can be regarded as a partial proof test that should generally be carried out much more frequently, for example weekly or daily, or even every shift change.

The frequency of proof testing should be determined to suit the application and to meet the safety requirements, but RTK recommends that the full proof test interval does not exceed 3 years.

In the following calculations, the following symbols are used:

T_1 = Proof test interval for full proof test
T_L = Lamp and internal audible test

22.8 Calculating PFD for each safety function

The PFD for each safety function is calculated by summing the PFDs of the sections in the chain from the input device to the output device. The SIL725 forms part of the safety function and the preceding reliability block diagrams reflect the architecture of the SIL725. These diagrams can be used as an aid to calculating the PFD for any safety function using the SIL725.

The following tables give PFDs for the 1oo1 and 1oo2 configurations previously described.

The formulae[§] used are

PFD = $\lambda^2 T_1^2/3$ for parallel voted (1oo2) elements

PFD = $\lambda T_1/2$ for series elements

	Alarm input channel, 1oo1
Base failure rate, λ_{DU}, pmh	0.129
Base failure rate, λ_{DU}, per year	1.13×10^{-3}
PFD for T_1 = 1 year	5.7×10^{-4}
2 years	1.1×10^{-3}
3 years	1.7×10^{-3}

	Alarm input channel, 1oo2, same input card	
	Input channel, 1oo2	Common parts
Base failure rate, λ_{DU}, pmh	0.033 each input	0.100
Base failure rate, λ_{DU}, per year	2.89×10^{-4} each input	8.76×10^{-4}
PFD for T_1 = 1 year	2.8×10^{-8}	4.4×10^{-4}
2 years	1.1×10^{-7}	8.8×10^{-4}
3 years	2.5×10^{-7}	1.3×10^{-3}

	Alarm input channel, 1oo2, different input card	
	Input channel, 1oo2	Common cause
Base failure rate, λ_{DU}, pmh	0.129 each input	0.013
Base failure rate, λ_{DU}, per year	1.13×10^{-3} each input	1.14×10^{-4}
PFD for T_1 = 1 year	4.3×10^{-7}	5.7×10^{-5}
2 years	1.7×10^{-6}	1.1×10^{-4}
3 years	3.8×10^{-6}	1.7×10^{-4}

	Motherboard, power, etc.	Safety relay output
Base failure rate, λ_{DU}, pmh	0.009	0.002
Base failure rate, λ_{DU}, per year	7.88×10^{-5}	1.75×10^{-5}
PFD for T_1 = 1 year	3.9×10^{-5}	8.8×10^{-6}
2 years	7.9×10^{-5}	1.8×10^{-5}
3 years	1.2×10^{-4}	2.6×10^{-5}

[§] See note at the end of this section

	Single LED alarm window	Internal audible
Base failure rate, λ_{DU}, pmh	0.009	0.019
Base failure rate, λ_{DU}, per year	7.88×10^{-5}	1.66×10^{-4}
PFD for T_L = 24 hours	1.1×10^{-7}	2.3×10^{-7}
1 week	7.6×10^{-7}	1.6×10^{-6}
1 month	3.3×10^{-6}	6.9×10^{-6}
6 months	2.0×10^{-5}	4.2×10^{-5}
1 year	3.9×10^{-5}	8.3×10^{-5}

The following tables show examples of the addition of the PFD figures to obtain the system PFD.

The following examples show how the above figures can be added to obtain the PFD of the complete SIL725 safety function. The examples each relate to one of the three configurations described previously, with the following assumptions:

- The proof test interval is one year
- The internal audible, the LED alarm window, and a safety relay output are all required as part of the safety function
- The LED alarm windows and the internal audible are tested once a week using the LAMP TEST button
- For simplicity, the PFD for a single LED alarm window is used rather than calculate for two LED alarm windows. When tested weekly, PFD is insignificant.

N.B. These examples are provided to illustrate how to derive the PFD of the SIL725 part of the safety function and will not be correct for other configurations and proof test intervals. It is the user's responsibility to derive the correct system PFD for his particular application.

Single channel 1oo1 safety function	
	PFD
Alarm input channel, 1oo1	5.7×10^{-4}
Motherboard, power, etc.	3.9×10^{-5}
Safety relay output	8.8×10^{-6}
Single LED alarm window	7.6×10^{-7}
Internal audible	1.6×10^{-6}
Total for SIL725 part of this safety function	**6.2×10^{-4}**

Two channel, 1oo2 safety function, using the same input card	
	PFD
Alarm input channel, 1oo2, same input card	2.8×10^{-8}
Alarm input channel, common parts	4.4×10^{-4}
Motherboard, power, etc.	3.9×10^{-5}
Safety relay output	8.8×10^{-6}
Single LED alarm window	7.6×10^{-7}
Internal audible	1.6×10^{-6}
Total for SIL725 part of this safety function	**4.9×10^{-4}**

Two channel, 1oo2 safety function, using different input cards	
	PFD
Alarm input channel, 1oo2, different input cards	4.3×10^{-7}
Alarm input channel, common cause	5.7×10^{-5}
Motherboard, power, etc.	3.9×10^{-5}
Safety relay output	8.8×10^{-6}
Single LED alarm window	7.6×10^{-7}
Internal audible	1.6×10^{-6}
Total for SIL725 part of this safety function	**1.1×10^{-4}**

Note concerning the formulae used to derive PFD:

The formulae used in the PFD calculation examples differ from the formulae and methods shown in IEC 61508-6, B.2.2.1 and B.2.2.2 in that they treat the dangerous detected failures as safe failures. This is justified as:

1. *The failure rate for failures detected by diagnostics is small compared to the other failure rates. (The diagnostic coverage is small.)*

2. *The SIL725 is normally configured so that failures detected by diagnostics cause the safety function to go to its safe state (relays de-energised), which is normal for a safe failure. (If the SIL725 is configured such that the diagnostic relay output is used to annunciate an equipment failure rather than to put the safety function into a safe state, then it may be necessary to use more complex PFD calculations.)*

3. *Therefore the error incurred using the simplified formula is small.*

4. *The total PFD of each safety function is likely to be dominated by the PFD of the input devices and final elements, further reducing the effect of any error.*

23. Commissioning

A qualified technician properly trained and authorised to work with this type of equipment should carry out commissioning and servicing operations.

The following procedure is a summary of the steps normally taken when installing an alarm system.

This is the absolute minimum requirement and will generally be supplemented by a number of additional checks relating to the particular application and installation.

STEP	FUNCTION
1	Check all external customer connections to the annunciator are free from earth faults.
2	Ensure the annunciator has been correctly earthed using appropriate sized cable.
3	Check that all customers wiring added during installation is secure and correctly wired.
4	Apply a 24vdc logic supply and check that the power on LED illuminates correctly.
5	Press the system test pushbutton to check that all active alarm channels flash and the audible alarm sounds in accordance with the programmed sequence.
6	Press the remaining pushbuttons required to control the programmed sequence.
7	Refer to the section on Configuration and check that all of the required functions have been correctly set.
8	Initialise each channel one by one from the field device to check that the laser printed film legend and filter colour matches the associated process.

24. Maintenance

Should it be necessary to remove any component part of the SIL725 Safety Annunciator for testing or checking, please ensure that the removed component is marked with the complete unit serial number. This is to ensure that component traceability is maintained.

24.1 No Special Tools

All normal maintenance and Configuration is carried out from the front of the annunciator without the use of special tools.

Filter and film legend changes and LED replacement are all undertaken by unclipping the front filter assembly.

24.2 Removing Filter Assemblies

See Section 3.4.

24.3 Changing Film Legend

See Section 3.4.

24.4 Changing LED Assemblies

After removal of the filter assembly the lamp holder will be visible.

The Test pushbutton can be pressed to ascertain if any LED's have failed

The LED assemblies are removed using a pair of pliers on a small PCB connecting tag.

The LED's are not polarised so can be fitted in either orientation.

24.5 Fuse Replacement

Two fuses protect the overall system, one protects the supply and motherboard (F1) and the other protects the feed to the alarm contacts (F2).

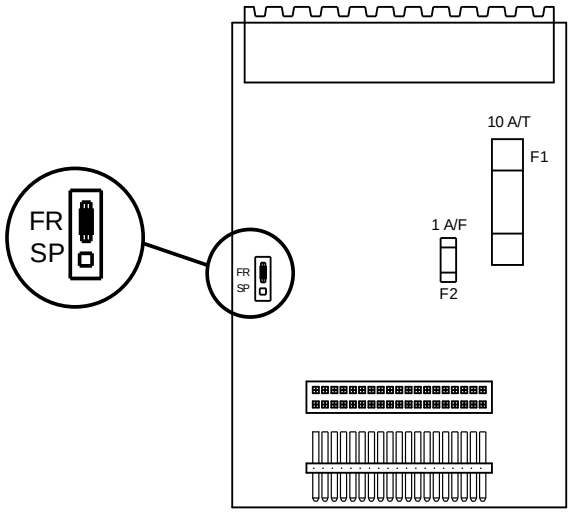
These are both situated on the supply card, which is fitted in the SPD module.

The location of the two fuses is shown below.

Take care to replace fuses with fuses of exactly the same type.

- F1 = Part No. FU-10A-002 10 amp Logic Fuse
- F2 = Part No. FU-1A-S01 1 amp Signal Supply Fuse

Spare fuses are supplied with all annunciator shipments.



25. Spare Parts Description

Only the manufacturer's recommended replacement parts shall be used within the SIL725 Annunciator

Alarm Card Types

There are 4 basic types of dual channel alarm.

CURRENT VERSIONS (Plastic Case Annunciator)

PART NO	DESCRIPTION	USED ON
CB5674SIL1-T	2 Channel alarm card	Large and Medium window versions Located in the upper slot of the cell
CB5674SIL2-T	2 Channel alarm card with repeat relays	Large and Medium window versions Located in the upper slot of the cell
CB5674SIL3-T	2 Channel alarm card	Large and Medium window versions Located in the lower slot of the cell
CB5674SIL4-T	2 Channel alarm card with repeat relays	Large and Medium window versions Located in the lower slot of the cell

Signal Supply Voltages

All card types are supplied suitable for operation from 24VDC signal supply voltages. The voltage levels are screen printed onto each card to indicate which version has been supplied. Alarm cards plug into the rear of the annunciator and once inserted automatically connect to a pre-tested LED display motherboard.

SPD Dual Card Assembly (Supply And LVL Card)

Current Versions

PART NO	DESCRIPTION	USED ON
CB7080POP-T	Supply Pushbutton Board	All SIL725 Annunciators
CB8306SIL1-T	Low Voltage Lock Out Board	All SIL725 Annunciators

Pushbutton Assembly

Part no SIL725-TAR-RTK

LED version

LED Assembly Part no P725LED-XX (where xx is the colour)

- RD-Red
- YW-Yellow
- AM-Amber
- WT-White
- BL-Blue
- GN-Green

26. Other RTK Products

RTK Instruments Ltd are fully ISO9001:1994 approved and manufacture a comprehensive range of complementary products from our factory in Knaresborough N. Yorkshire for use in the Industrial Control and Instrumentation field per the summary list provided below.

All standard products come complete with a 5 year guarantee

- Sequential event recorder
- Alarm management systems
- Configurable remote logic alarm systems
- Hazardous area alarm systems
- Power supplies
- Intrinsically safe alarm and status display products including:-
- LED beacons
- Sounders
- Led clusters

Please ring the sales office on 0044 (0) 1423 580 500 for latest product information or visit our web site www.rtkinstruments.com

FUNCTION SETTING LABEL

```
   F0  -         - Contact state
   F1  - INVIP   - Normally Open or Normally
                   closed Contact
   F2  - INVRLY  - Output Relay energised or
                   de-energised
   F3  - ARES    - Auto Reset
 * F4  - REP     - No Latch Operation
   F5  - RB      - Ringback
   F6  - TBUF    - Two button operation
   F7  - REF     - Reflash single operation
 * F8  - GPAR    - Group Relay A Reflash
** F9  - GPBR    - Group Relay B Reflash
   F10 - F0      - First up sequence F0
 * F11 - F1      - First up sequence F1
   F12 - F2      - First up sequence F2  ┐ FFAM2
   F13 - F3      - First up sequence F3  ┘ (Alarm model
   F14 - FUPA    - First up Group A          only)
   F15 - FUPB    - First up Group B
** F16 - FUPC    - First up Group C      (Alarm model)
** F16 - ICP     - Input from comm port  (Comms model)
** F17 - FUPD    - First up Group D      (Alarm model)
** F17 - NU      - Logic from comm port  (Comms model)
   F18 - RFA     - Relay follow logic
   F19 - RFIP    - Relay follow input    ┐ RFD
   F20 - CSTR    - Disable relay operation ┘
                   on system test
   F21 - GPA     - Group Relay A
   F22 - GPB     - Group Relay B
   F23 - HNA     - Horn A
   F24 - HNB     - Horn B
```

SIL2 Specification

'*' Function is NOT compatible

'**' Function is NOT supported

Refer to SIL manual for clarification

Function Setting per Alarm Sequence

FUNCTION NUMBER	FEATURE DESCRIPTION	STD ISA SEQUENCES				FIRST-UP ISA SEQUENCES				STATUS ONLY
		M	A	A-4	R	F1A	F2M-1	F3A	FFAM2	
F3	Manual / Automatic Reset	OFF	ON	ON	OFF		OFF	ON	OFF	OFF
F4	*NOT COMPATABLE WITH SIL725 ANNUNCIATORS*									
F5	Ringback Sequence	OFF	OFF	OFF	ON		OFF	OFF	OFF	OFF
F6	2 Pushbutton Operation	OFF	OFF	OFF	OFF		OFF	OFF	OFF	OFF
F10	First Up Seq. FO	** Set To On For Slow Flash					OFF	OFF	OFF	OFF
F11	*NOT COMPATABLE WITH SIL725 ANNUNCIATORS*									
F12	First Up Seq. F2	OFF	OFF	OFF	OFF		ON	OFF	OFF	OFF
F13	First Up Seq. F3	** Set To On For Fast Flash					OFF	ON	ON	OFF
F14	First Up Group A	OFF	OFF	OFF	OFF	When using First-Up sequences Functions F14 to F17 allow the user to link each channel into the required First-Up Group A, B, C or D. Channels can linked to more than one group if required.				OFF
F15	First Up Group B	OFF	OFF	OFF	OFF					OFF
F16	NOT SUPPORTED *ON SIL725 ANNUNCIATORS*									OFF
F17	NOT SUPPORTED *ON SIL725 ANNUNCIATORS*									OFF
F23	HNA Horn Drive	Channels selected to F23 will drive the internal horn and HNA horn relay								OFF
F24	HNB Horn Drive	Channels selected to F24 will drive the HNB horn relay only								OFF

** Note 1 When using Std. ISA sequences Functions F10 or F13 sets the preferred Flash Rate, F10 = slow flash F13 = fast flash.